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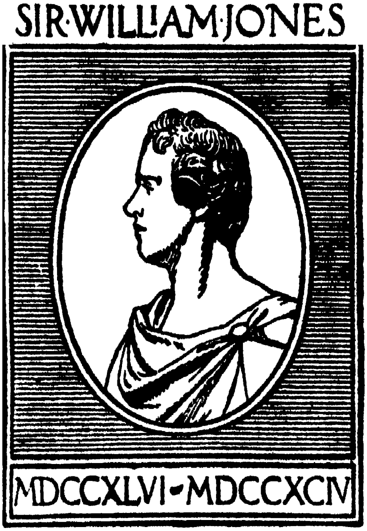

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JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.

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Vol. XVIII —1922.

1. The Homology of the Weberian Ossicles.

By Sunder Lal Hora, M.Sc., *Assistant Superintendent, Zoological Survey of India.*

(Communicated with the permission of the Director, Zoological Survey of India.)

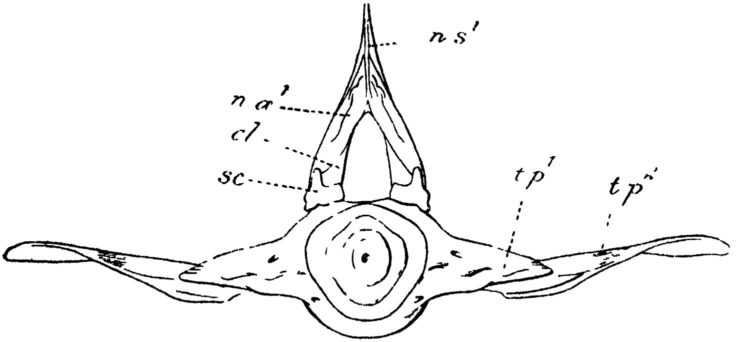
The work, of which a summary is published here, was undertaken at Lahore in 1918–19 under the guidance of my professor, Lt.-Col. J. Stephenson, to whom my best thanks are due. At that time I was engaged in the detailed morphological study of the Weberian apparatus in Cyprinoid fishes such as *Labeo rohita*, but my attention was diverted to the study of their homology by finding considerable variation in the structure of the tripus. Since I have joined the Zoological Survey of India, pressure of other work has not left me much time to study this problem further. This short note is published with a desire to bring to the notice of other workers the views I hold regarding the homology of the four ossicles which, with an interossicular ligament, form the Weberian apparatus.

Bridge and Haddon[1] have critically examined the views held by previous writers regarding the homology of these ossicles and after an exhaustive study of the anatomy of the Siluroid fishes have summarised their own views on the subject. For all previous references, therefore, one has to consult their valuable paper. In the writing up of my descriptions I have adopted their nomenclature.

---

[1] Bridge and Haddon, *Phil. Trans. Roy. Soc. London*, CLXXIV, pt. 1. B., pp. 260-261 (1893).

In *Labeo rohita* the sides of the neural arches of the first vertebra are incomplete. There is a wide gulf between the dorso-lateral portion of the neural arch bearing the spine and the centrum. The two anterior ossicles of the Weberian apparatus—the claustrum and the scaphium—bridge over this gulf and in a dried skeleton almost complete the neural arch of the first vertebra. The scaphium has always been homologized with the neural arch of the first vertebra, but the claustrum has been regarded either as a neural spine of the first vertebra or as a part of the skull. In *Labeo rohita* and also in several other Cyprinoid fishes that I have examined, the first vertebra possesses a distinct neural spine and so the claustrum evidently cannot represent that structure As regards the second view, I have not been able to find any evidence from an examination of the occipital region of the skull that the claustrum once formed a part of it I am of opinion that the claustrum is another piece of the neural arch of the first vertebra. Its very position strengthens my conclusions.



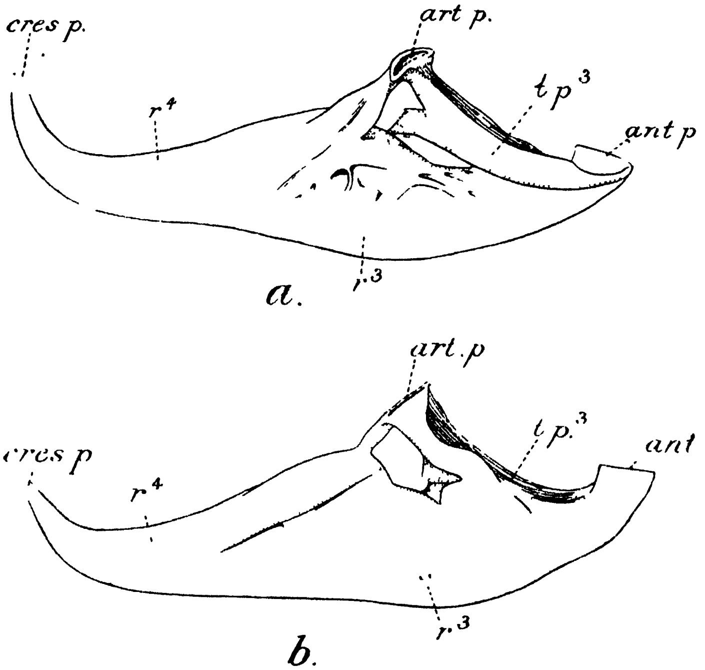
TEXT-FIG. 1—Front view of first vertebra in *Labeo rohita* showing relative positions of claustrum and scaphium *n.s*^{1} = neural spine of first vertebra; *n.a.*^{1} = neural arch of first vertebra; *t.p.*^{1} = transverse process of first vertebra; *t.p.*^{2} = transverse process of second vertebra; *cl.* = Claustrum ; *sc.* = scaphium

The intercalarium has usually been regarded as a modified neural arch of the second vertebra, but Sagemehl[1] was of opinion that it represented the rib of the second vertebra. According to Bridge and Haddon, the ossicle is a compound bone consisting of two elements—the neural arch of the second vertebra and its transverse process. In *Labeo rohita* the second vertebra possesses a well-defined transverse process, with which I think the rib has fused. In my opinion, therefore, the intercalarium represents a part or whole of the neural arch of the second vertebra.

---

[1] Sagemehl, *Morphol Jahrb.* X, p. 1 (1885.)

The tripus is by far the largest ossicle. It has been homologised with either the transverse process of the third vertebra or its rib.[1] But I have found it to be a compound bone formed by the coalescence of three distinct elements. The drawings given below from actual specimens illustrate this clearly. In fig. *a*, there is a distinct bony element ($t.p.^3$) which runs from the dorsal aspect of the anterior process of the tripus (*ant.p.*) to its articular process (*art.p*). Below the articular process it is separated from the main body of the ossicle by two cavities, which when followed in a large series of preparations, become gradually reduced and ultimately vanish altogether. Thus the two distinct elements at the anterior end become fused and indistinguishable. I am of



TEXT-FIG. 2—Tripus, a compound bone.
a. Same as seen from above.
b. Same as seen from below.

Both figures are not drawn from the same specimen.

Ant.p. = Anterior process of tripus; $t.p.^3$ = transverse process of third vertebra; *art.p* = articular process of tripus; $r.^4$ = rib of fourth vertebra; *cres p.* = crescentic process of tripus; $r.^3$ = rib of third vertebra.

Regan, *Ann. Mag. Nat Hist.* (8) VIII, p. 14 (1911) opinion that this piece of bone represents the transverse process of the third vertebra, which has become directed forwards and in its origin corresponds to the other transverse processes. When the transverse process of the third vertebra became directed forwards, its rib was inflected backwards and for some distance lay close to the transverse process. The portion of the ossicle marked r^3 represents this rib The crescentic portion of the tripus (*cres.p.*) is formed by another element as is shown in fig. *b*. It runs as far forwards as the articular process. This new element in the posterior region of the tripus is the rib of the fourth vertebra, whose transverse processes have been modified to form a platform against which the bladder rests anteriorly.

My views regarding the homology of the Weberian ossicles may now be summed up as follows:—

Claustrum = a part of neural arch of first vertebra.
Scaphium = a part of neural arch of same.
Intercalarium = neural arch of second vertebra.
Tripus = transverse process and rib of third vertebra + rib of fourth vertebra

Thus it will be seen that the missing ribs and transverse processes of the third and fourth vertebrae are accounted for. The first two vertebrae possess well developed transverse processes, but apparently their ribs are missing. I suppose that either the ribs of these vertebrae have fused with their respective transverse processes. or that they have been lost altogether for want of room, since the processes are greatly enlarged and are directed outwards and slightly backwards.

2. The Modification of the Swim-bladder in Hill-stream Fishes.

By Sunder Lal Hora, M.Sc.,
Assistant Superintendent, Zoological Survey of India.

(Read at the Ninth Annual Meeting of the Indian Science Congress and communicated with the permission of the Director, Zoological Survey of India.)

In the taxonomy of fishes great importance is attached to the presence, form and position of the swim-bladder. It is supposed to be a hydrostatic organ and its size and extent, so far as I know in Cyprinoidea, is directly correlated with the performance of this function. In a typical Cyprinoid fish, such as *Labeo rohita,* the bladder is large and lies free in the abdominal cavity. It is constricted in the middle to form an anterior and a posterior chamber and is joined to the oesophagus through a pneumatic duct which opens in its constricted region. In those Cyprinoid genera that live in rapid-running waters and consequently lead a ground-habit of life, the bladder undergoes considerable degeneration; this consists firstly in the gradual reduction of the two chambers and the ultimate disappearance of the posterior, and secondly in the thickening of the walls. In extreme cases such as some loaches of the genus *Nemachilus*, the bladder becomes completely enclosed in a bony capsule derived from the transverse processes of the adjacent vertebrae.

In the genus *Psilorhynchus*, the members of which inhabit the torrents of north-east Bengal and Assam, the posterior chamber is greatly reduced and the anterior is covered by a thick fibrous coat. In *Nemachilus vittatus*, known from the lakes and streams in the Kashmir Valley, the anterior chamber is laterally flattened and covered by a bony capsule, while the posterior chamber is small and thick-walled. The pneumatic duct is still present. In *Adiposia rhadinaea*, the anterior chamber is divided into two lateral chambers, which are connected by a canal, while the posterior chamber is minute and bulb-like; the whole of the bladder is enclosed in bone and the pneumatic duct has disappeared. In several species of the genus *Nemachilus* the structure is very similar to that described in *Adiposia rhadinaea* with this difference, that the posterior chamber vanishes altogether. In extreme cases such as *Balitora brucei*, the two lateral portions of the anterior chamber are much reduced and are somewhat separated from each other.

The various phases described above represent a continuous series in which the posterior chamber is being gradually eliminated and the anterior greatly reduced and enclosed in a bony capsule. The members of the genus *Diplophysa* are very peculiar. They inhabit the deep waters of Central Asia and in that situation require a hydrostatic organ. They posses a fairly well-developed bladder free in the abdominal cavity and have in addition a typical bladder of the *Nemachilus* type anteriorly. The free bladder has a pneumatic duct at its anterior end and it appears to me that either it is a new acquisition to meet the new requirements or as Dr. Annandale suggests it represents the posterior chamber of the normal Cyprinoid bladder, which has become nipped off. The latter proposition is strengthened by the type of bladder met with in the genus *Botia*. In *B. hymenophysa*, the members of which inhabit the sluggish streams of Manipur and Burma, the anterior chamber is partly enclosed by bone, while the posterior lies free in the abdominal cavity and is fairly well developed. In *Botia almorhae*, from the Almorah Hills of the United Provinces, the whole of the bladder is reduced; the anterior chamber is enclosed in a bony capsule, while the posterior chamber is long and slender and lies free in the abdominal cavity. To derive a bladder of the *Diplophysa* type from that of one described for *Botia hymenophysa* is very easy. What is required is the complete separation of the two chambers On the other hand the members of the genus *Diplophysa* are closely related to those of *Nemachilus*, and it is quite possible that they are derived from them for the difference between the two lies in the fact that in *Diplophysa* there is a free bladder with a pneumatic duct while in *Nemachilus* there is none. Assuming the close relationship between advanced members of *Nemachilus*, in which the anterior chamber has become divided up into two lateral chambers, and those of the genus *Diplophysa*, it appears to me quite probable that the anterior bladder of *Diplophysa* corresponds to that found in *Nemachilus*, while the posterior bladder is a totally new structure evolved for life in deep waters secondarily. Which of the two propositions is correct, is very difficult to judge.

Having described some of the types of bladders met with in hill-stream fishes, it remains to account for the modifications enumerated above. The reduction of the bladder seems to be correlated with the ground-habit of these fishes. Having this habit they possibly do not make vertical movements and, therefore, do not need a hydrostatic organ. But why the reduced bladder should be enclosed in bone, is not clear to me. I have found on dissection that the vestigial bladder is connected through the Weberian Ossicles to the internal ear and comparatively speaking the ossicles are not as much reduced as the bladder. It is possible, therefore, that a bony capsule is developed round the bladder to provide it with a protection so that it may be able to carry on the function, which it performs in correlation with the ear. Or perhaps according to the neo-lamarckian school, the reduced bladder caused some irritation on the adjacent bones and consequently a capsule of bone was developed. At present, however, nothing can definitely be said on this point. The reason for the reduction of the bladder is quite apparent, for in fishes that live in rapid waters a balloon-like structure is of great disadvantage. What animals living in mountain torrents require is solidity and not bouyancy.

3. Some observations on the Oral Apparatus of the tadpoles of *Megalophrys parva* Boulenger.

By SUNDER LAL HORA, M.Sc.,
Assistant Superintendent, Zoological Survey of India.

(Read at the Ninth Annual Meeting of the Indian Science Congress and communicated with the permission of the Director, Zoological Survey of India.)

During a recent visit to the Khasi Hills I obtained a large number of specimens of the tadpoles of the genus *Megalophrys* in a small stream at Dumpep. They were found in clear and fairly rapid-flowing water among weeds. The tadpoles were brought alive to the bungalow and were kept under observation for four to five hours. During the short time at my disposal, I could not make extensive observations on the probable function of the float and, moreover, I was then quite ignorant of the literature on the subject. On coming back to Calcutta and going through the literature, I found that my observations differed to a certain extent from those previously recorded and, I therefore, take this opportunity to place them on record.

I am indebted to Dr. N. Annandale for the identification of my specimens and for the great help and valuable suggestions that he gave to me in the preparation of this note

It was observed that the funnel only expanded when the tadpole came to the surface. In this position the surface immediately above the funnel slightly projected upwards. The animal was occasionally seen to be parallel to the surface but more often it either lay obliquely against the side of the bowl or hung vertically downwards from the surface film as figured by Dr. Gadow.[1] Under water on the other hand the funnel was always folded and presented the appearance of two horns turned upwards and inwards The animal was able to float even with the funnel folded. The tadpoles under water were seen either lying flat at the bottom, standing obliquely in a vertical position by resting their tail at the bottom or floating in the middle of the water. When floating the tail was always slightly curved to secure equilibrium and stability By blowing over a tadpole floating under water, I was able to carry it round and round the bowl without disturbing it.

It was also observed that the tadpole could not lie at the bottom for an indefinite period but after every ten to fifteen minutes it came to the surface, remained there with its funnel expanded for a short time and then sank under water with the funnel folded. When the funnel was expanded the tadpoles were observed to give out fairly large bubbles of air and sometimes solid particles were also ejected from the mouth cavity.

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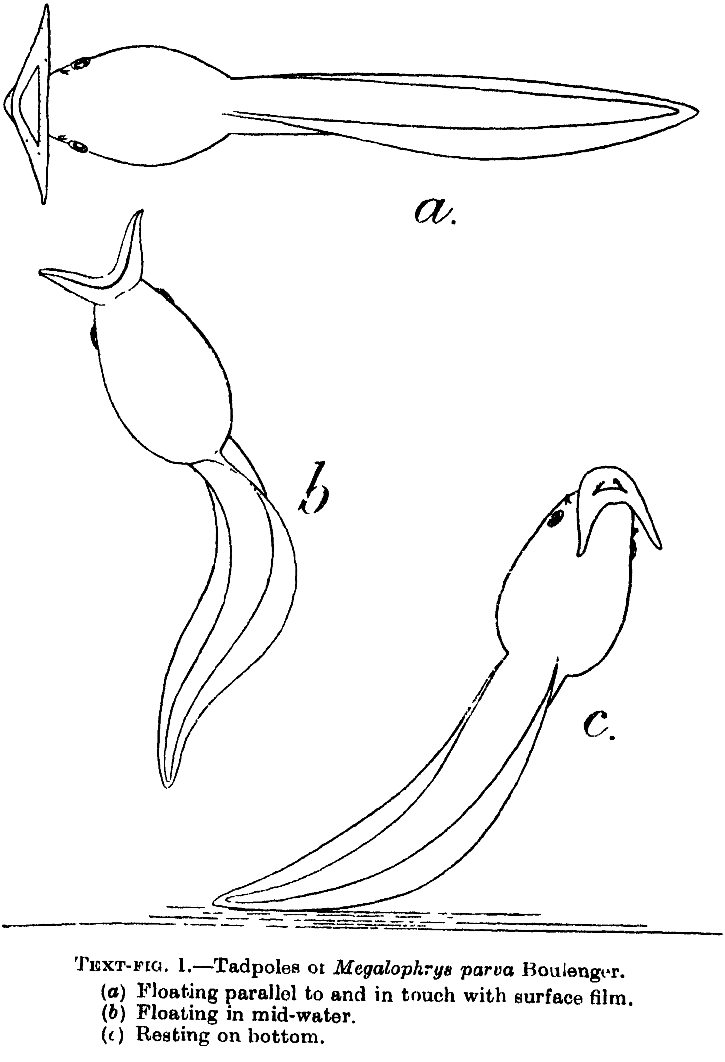
[1] Gadow, Amphibia and Reptiles (*Cambridge Nat. Hist.*), p 59 (1901).



TEXT-FIG. 1.—Tadpoles of *Megalophrys parva* Boulenger.
(*a*) Floating parallel to and in touch with surface film.
(*b*) Floating in mid-water.
(*c*) Resting on bottom.

Great controversy centres round the probable function of the lozenge-shaped apparatus surrounding the mouth of tadpoles of several species of the genus *Megalophrys*. The following functions have been assigned to it so far:—

(i) Prof Max Weber,[1] who observed this interesting structure for the first time, assigned to it the function of flotation.

(ii) Dr. Gadow[2] suggested that the teeth on the inner side of the structure-were used for scraping the leaves of water-plants, while Dr. Van Kampen[3] attributed to the teeth the function of rasping the algal slime.

(iii) Besides the two functions given above, Dr. Annandale[4] in his latest paper on the subject added two more, firstly, respiration and secondly crawling.

(iv) Dr Malcolm Smith[5] has quite recently advanced the view that the chief function of the funnel is to assist the animal in feeding and has doubted the possibility of its acting as a float during floods

I take up the various functions attributed to this structure one by one and discuss them separately in the light of my observations and also in the light of the evidence afforded by the morphological and histological study of the structure of the float, which is given towards the end of this short note

My observations have convinced me that the oral apparatus is capable of acting as an efficient organ of flotation. The very fact that I was able to carry a floating tadpole round and round the bowl by gently blowing over it is very significant in this connection. Dr. Annandale's[6] suggestion that the very action of the folding of the funnel causes the animal to sink is not borne out by my observations. The animal is capable of floating irrespective of the fact that the funnel is expanded or folded

Though I have not made any observations on the feeding habits of these tadpoles, in the absence of a strong musculature in the funnel, it seems improbable that the teeth on the inner side of the structure are capable of either scraping the leaves of water-plants or rasping algal slime In the case of the hill-stream fishes, which have largely to depend on algal slime for their existence, the jaws are specially strong and are provided with big muscles to work them

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[1] Max Weber, *Ann. Jardin Bot Buitenzorg*, Supp II, p. 5 (1898)

[2] Gadow, Amphibia and Reptiles (*Cambridge Nat Hist*) p. 59 (1901)

[3] Kampen, Weber's *Zoolog. Ergebn* IV, p 409 (1907).

[4] Annandale, *Rec Ind. Mus.* VIII, p. 30 (1912)

[5] Malcolm Smith, *Journ Nat Hist. Soc Siam* II, p 271 (1917).

[6] Annandale. *Fascic. Malay.*, *Zool*, p. 280 (1903)

Dr. Annandale's[1] suggestion that the funnel is used for crawling over vertical rocks is quite feasable. The muscular energy for this action, as he points out, is provided by the powerful tail, while the role of the oral apparatus is quite passive in the performance of this function. But the study of the funnel shows that that cannot be its primary function.

Dr. Annandale informs me that the observations, he made on the habits of these tadpoles in 1906, have recently been confirmed by him by keeping the tadpoles in an aquarium.

As regards the function of respiration, I am not able to express a definite opinion The fact that the animal rises to the surface and expands its funnel for a short time when in contact with air, favours the view that the funnel is possibly used as a secondary respiratory organ. Tadpoles of *Microhyla achatina*[2] behave exactly in the same way, as has been recently observed by Malcolm Smith Their funnel only expands when they come to the surface, when, according to him, the purpose of the oral apparatus " is to act as a funnel, and to furnish as large an area as possible for catching any minute particles floating upon the water, and which are drawn towards it by the strong sucking action of the creature." The same explanation is offered by Dr. Malcolm Smith for the tadpoles of *Megalophrys montana* I have not made any observations on similar lines and am, therefore, unable to discuss this view.

I agree with Dr. Annandale[3] that the histological structure of the funnel does not reveal any vascular tissue of blood vessels and in the absence of such a tissue it seems wrong to assign to it the function of an accessory respiratory organ It may, however, be pointed out that fishes which live in mountain torrents have their gill-openings greatly reduced and have in all probability their paired fins modified for the function of respiration.

Another point worth considering here is the probable use of the teeth present on the inner side of the funnel. I have already discussed Dr. Gadow's and Dr Van Kampen's views regarding them and have not been able to find any evidence from the minute structure of the tissue to support them According to Dr. Malcolm Smith the teeth act as a filter to hold up particles that are too big for assimilation. Dr. Annandale considers that the arrangement of the teeth on the funnel supports Dr. Malcolm Smith's view The teeth are arranged in such a manner that a definite groove is formed between them on each side of the funnel, leading from the lateral angle down to the mouth and both Dr. Annandale and Dr. Gravely have observed a current of water containing minute particles flowing along this groove in the living animal, in which they tell me that the groove is much more conspicuous than in preserved material. If one were to agree with Dr. Malcolm Smith's view regarding the feeding habits of these tadpoles, the function he assigns to the teeth is quite probable, but for the reasons given above I do not propose to enter into any discussion at present on this subject. Dr. Annandale, moreover, suggests that the ridges on the float of *Microhyla achatina* and the so called teeth on the funnel of *Megalophrys* tadpoles, are probably used for breaking through the surface film when the tadpoles rise up and expand their funnel, but we are yet ignorant of the exact purpose of the tadpole in rising up to the surface. I agree with Dr. Annandale as regards the structure and arrangement of the teeth. In section they appear as ridges of the body-wall, the outer cells of which are filled with black pigment and are somewhat cornified. In most of the points I agree with Dr. Annandale's description of the minute structure of the funnel, but I believe that the central mass between the two walls

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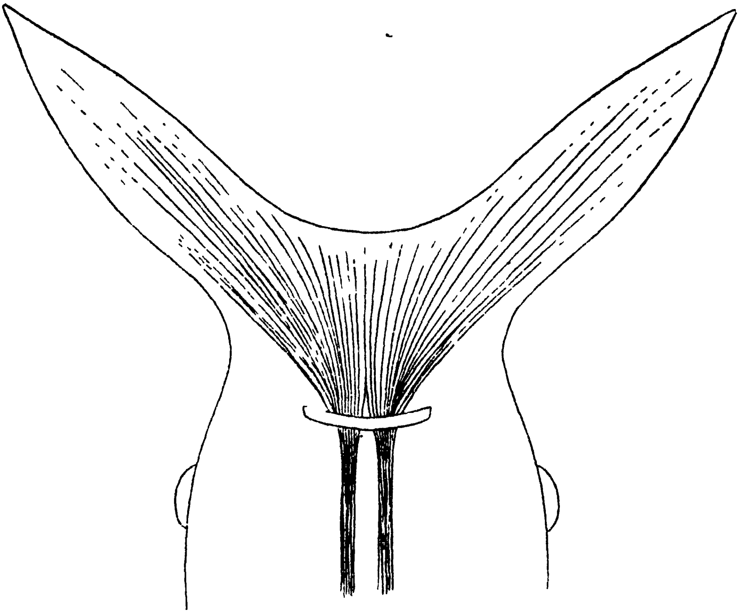
[1] Annandale, *Journ. As. Soc. Bengal* (N.S.) II, p. 292 (1906).

[2] Malcolm Smith, *Journ. Nat Hist. Soc. Siam* II, p. 36, pl. 1, figs A1, A2, A4 (1916).

[3] Annandale, *Fascic. Malay., Zool.* II, p. 275 (1903).



TEXT-FIG. 2.—Dissection of oral apparatus from ventral surface to show its muscular arrangement (diagrammatic) consists of a loose connective tissue, whose main function appears to support the funnel.

The musculature of the oral apparatus is quite interesting. I agree with Dr. Annandale as regards the arrangement of the muscle bundles in the funnel itself. My dissections show that the muscles are only present in the "ventral" wall and that they arise in a semicircle below the mouth The number of branches that originate from the semicircle appears to be indefinite but the whole system is distributed in a fan-shaped manner The shorter bundles are situated in the middle, while the longer radiate to the side of the funnel Behind the semicircle the muscles are continued backwards as two well-marked bundles running parallel to each other and posteriorly fixed on to the hyoid apparatus. One of these bundles was examined microscopcially and was found to consist of striped muscles. By pulling these two muscles backwards, I was able to expand the funnel. So it is clear that the unfolding of the funnel involves a muscular action on the part of the tadpole itself.

LITERATURE.

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4. Resumé of Recent Progress in our Knowledge of the Indian Wasps and Bees.[1]

By CEDRIC DOVER, F.E.S.

(Read at the Ninth Annual Meeting of the Indian Science Congress.)

When Lt. Col. C. T. Bingham's volume on the wasps and bees in the "Fauna of British India" series appeared in 1897 about a thousand species were described; but the stimulus the work gave to the study of the group has caused the number of species now known from the Indian region to be almost doubled (as the writer of the review of the book in *Nature* predicted), and numerous other additions to our knowledge of 1897 have also been made. Of recent years the fact that this mass of information is scattered through a number of journals no doubt accounts for the general falling-oft of interest in the subject by entomologists in this country, and now the only really serious workers on the group are a few European specialists.

It is hoped that this brief review will draw the attention of the Editors of the "Fauna" series to the urgent need of a new edition of Bingham's volume with all up-to-date information. This I am afraid would be too laborious a task for one man so that it would perhaps be best to issue the work in three volumes: Introduction and Diploptera, Fossores, and Anthophila; each written by a specialist or some one willing and in a position to undertake the work.

Of recent Indian entomologists who have done work on the Hymenoptera I may mention Mr. T. V. Ramakrishna Aiyar of the Agricultural College in Coimbatore, who has rendered yeoman service to those contemplating the study of the wasps and bees by compiling a catalogue of the new species,[1] which with a few additions could easily be brought up-to-date Mr. G. R. Dutt of Pusa appears to have confined himself mainly to the biological aspect of the subject, but has also published a few purely systematic papers on the Fossores.[2] His paper in the Entomological series of *Memoirs of the Department of Agriculture* for 1912 is one of the most thorough investigations into the life-history and habits of the group that has yet been published in the East. Notes on the habits of Aculeates will also be found in Lefroy's "Indian Insect Life" and Dr. Gravely has listed a large proportion of the literature in his paper on the habits of Indian Insects, etc., in *Rec. Ind. Mus.* XI, p. 492, 1915. A number of notes have appeared in the Bombay Journal and the Pusa publications.

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[1] *Journ. Bomb. Nat. Hist. Soc.* XXIV–XXV, 1916–17.

[2] See *Rec. Ind Mus.* XVI, p. 259, 1919; also *Mem Dept Agric. Ind. Entom. Series*, VII, p. 29, 1921.

The late Mr. C. A. Paiva of the Indian Museum was much interested in the Aculeate Hymenoptera, but his more serious studies on the Rhynchota prevented him from doing really original work on the group. He did, however, publish a few papers containing records of the known species in *Rec. Ind. Mus.* from 1907-12 and one in *Journ. As. Soc. Bengal* (n. s.) II, p. 347, 1906. The Apidae of the Abor expedition were worked out by him and the wasps by Col. Nurse.[1] Nurse collected largely in Western India and wrote a number of papers, mostly on his own collections which have appeared in *Ann. Mag. Nat. Hist.* and *Journ. Bomb. Nat. Hist. Soc.* from about 1900–1910. Col. Bingham himself also published[2] till 1908, and Mr. Peter Cameron's prolific but none too steady work on Hymenoptera in general is too well known to need mention here. I must not forget to mention Mr. O. S. Wickwar's paper on Ceylonese Aculeates in *Spolia Zeylanica*, II, 1908.

The recognised specialists of to-day are all resident outside India. Mr. Rowland E. Turner is the living authority on the Fossores. He has probably done most work on Australian forms, but has also published many papers on Oriental species in *Ann. Mag. Nat. Hist.*, *Proc. Zool. Soc. Lond.* and *Trans. Ent. Soc. Lond.*, and in Indian publications. So many changes have been made in the arrangement of the fossorial wasps that I am afraid few but himself could assign a collection even to their proper genera, and I think he would do Indian entomologists a great service were he to publish a synopsis of the Indian genera with notes.

The untimely death at the early age of thirty-three of Mr. Geoffroy Meade-Waldo of the British Museum has deprived entomology of one of its most steady workers. He was a recognised authority on Diploptera and had also done considerable work on the bees. Most of his papers on Indian forms appeared in *Ann. Mag. Nat. Hist.* from 1910–16.

Professor T. D. A. Cockerell of the University of Colorado is now the chief living expert on the Apidae. The major portion of his work on Indian forms is contained in his series of papers entitled "Descriptions and Records of Bees" in *Ann. Mag. Nat. Hist.* for the last twenty years, but notes by him relative to Indian species will also be found in a number of other journals. Quite recently he wrote me that he is contemplating a classification and check-list of the bees of the world showing in what museums various species may be found This would certainly be a very valuable contribution to Apidology and one to which every entomologist will look forward.

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[1] *Rec. Ind. Mus.* VIII, p. 75 and p. 443, 1912–14.

[2] Mainly in *Ann. Mag. Nat. Hist.*, *Journ. Bomb. Nat. Hist. Soc.*, and one in *Rec. Ind. Mus.*

We cannot overlook the work of Mr. Ashmead on the classification of the Hymenoptera, but unfortunately the material at his disposal was not extensive and as a consequence his work is open to much criticism. His papers appeared in the *Canadian Entomologist* from 1899–1903 and *Trans. Amer Ent. Soc.* 1903.

The Rev. F. D. Morice and Mr. J. H. Durrant a few years ago reproduced a long-lost paper by Panzer in *Trans. Ent. Soc. Lond.* 1914 and treated it as if it were valid The "Erlangen list" as it is called has, I think, only added confusion to an already somewhat confused subject, for opinion is divided as to its validity. Mr. Morice is a well known authority on Hymenoptera

My own studies have so far been only of a preliminary nature and I cannot claim to have published anything very valuable. I have, however, with the assistance of Mr H. Srinivasa Rao worked out the Diploptera in the collection of the Indian Museum and have also compiled a paper on Fossores consisting only of additions to the geographical distribution of the species described by Bingham with notes on synonymy, etc, culled from the literature. An annotated list of the Hymenoptera of Barkuda, an island in the Chilka Lake, has been published in *Rec. Ind Mus.* XXII, 1921, the journal in which the other papers will also probably appear. Of the bees I have determined all our specimens of the genera *Xylocopa* and *Bombus* and a short note on them has recently been published in *Rec. Ind. Mus.* XXIV, 1922. With regard to the genus *Xylocopa*, I would draw the attention of Indian Hymenopterists to a paper by Dr. H. Brauns which gives some interesting notes on the wintering habits of South African species Similar work could perhaps be done here by patient investigators.[1] At Professor Cockerell's suggestion Mr. S. H. Ribeiro of the Zoological Survey and I are at present drawing up an annotated and synonymic catalogue of the bees of India, Burma and Ceylon, and he has promised to edit it and to incorporate a number of MS. notes that he made on a recent visit to Europe. It is probable that we will also catalogue the Diploptera and the Fossores.

At the risk of being guilty of a slight digression I would like to make a few remarks on that most interesting little group of the Parasitica—the Mymarides. It is regarded by some as a distinct family, while others place it in the Proctotrypidae. In *Genera Insectorum*, 1909, it is classed as a subfamily of the Chalcididae and I suppose this arrangement is generally accepted. The group was monographed by Professor Westwood in 1879 in *Trans. Linn. Soc. Lond.* (11), I. *Mymar* has been taken by sweeping among low herbage, and Dr. Annandale has described [1] a new species of *Alaptus* [2] which dropped into clove oil while he was doing microscopic work Recently I found *Mymar taprobanicus*, a Ceylonese species of which many specimens were collected about fifty years ago, in a collection of insects which I received from Mr. C. N. Barker of the Durban Museum. So far as I know the species has not been taken lately in Ceylon and as no species of the genus has ever been taken in any part of Africa, the record is of considerable interest. Unfortunately the slide of the insect has been damaged, but Mr. Barker has promised to send me specimens should he ever obtain any.

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[1] I believe this paper will be published before long in the Journal of the Biological Society of Willowmore, Cape Colony I hope shortly also to publish a note on the life-history and synonymy of *Xylocopa aestuans*.

It might now be useful to give a few comparative notes with our knowledge of 1897 under each family. For convenience I have adopted the arrangement given by Bingham

Family MUTILLIDAE.

About 250–300 species are now known from our limits as compared with the 119 described by Bingham. A thorough revision will of course cause a large reduction, as the greater number of the forms have been described by Cameron, whose work as I have already said was not of the soundest. The genus *Apterogyna* and its allies are dealt with by Saunders in *Ent.. Mag* 1889, p. 228. The majority of Cameron's species have been described in *Mem. Manch. Phil. Soc.* from 1896–1900, and Nurse's in *Journ. Bomb. Nat. Hist. Soc* 1902, and *Ann. Mag. Nat. Hist* 1903. Andre has a paper in *Ann. Soc. Ent. France*. LXVII, 1898, and in *Deuts. Ent. Ziets.* 1907 he gives a list of Ceylonese species with descriptions of new forms, while Turner in *Spolia Zeylanica*, 1911 describes a number of species from Ceylon. Bingham reports on a collection from the Indian Museum in *Rec. Ind. Mus.* II, 1908. Species of *Odontomutilla*, *Rhopalomutilla*, *Spilomutilla*, *Promecila*, and *Dasylabris* have also been described from within our limits [3]

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[1] *Rec. Ind. Mus* III, p. 299 (1909).

[2] It might be of interest to note here that Signoret, *Ann. Soc. Ent. France* (4), VIII, p. 371 (1868), records *Alaptus* as one of the chief enemies of the Aleurodes.

[3] Cf. *Ann. Soc. Ent. France*, 1903, pp 426–27; *Spol. Zeyl.* VIII, pp. 111 and 151, 1911; and *Deuts. Ent. Zeits.*, 1907, pp. 252 and 283.

Family THYNNIDAE.

The genera and species are listed by Turner in *Genera Insectorum*, 1910. *Iswara*, a genus closely allied to *Myzine* of the Scollidae, is now placed in that family. Many new species from the Indian region have not been described.

Family SCOLIIDAE.

This group has been split up into a number of subfamilies, many changes have been made in the generic names, and about fifty or more new species have been described since 1897. Turner has some important papers in *Ann. Mag. Nat. Hist.* 1908-09, and in *Proc. Zool. Soc. Lond.* 1912 he deals with the species of the genus *Elis* as understood by him.

Family POMPILIDAE.

In the paper previously mentioned Morice and Durrant showed that the typical genus *Pompilus* was found a few years earlier to have been called *Psammochares* and the family should therefore be called Psammocharidae. This is yet another instance of one of those unfortunate changes which are the result of a strict appliance of the rules of priority. The family is now one of the most difficult for the beginner to tackle and a definite concept of each of the numerous genera has not yet been published collectively. Over a hundred new species have been (often vaguely) described. The majority of the descriptions have appeared in *Journ. Bomb. Nat. Hist. Soc.*, *Ann. Mag. Nat. Hist.* and *Rec. Ind. Mus.* from 1900–08.

Family SPHEGIDAE.

Modern authorities regard sections of this group as distinct families. About 300 or more new species have been described and some new genera. The literature is rather scattered. Full references will be found in Aiyar's catalogue.

Family RHOPALOSOMIDAE.

The position of this family has always been a source of contention among hymenopterists Morley in describing *Rhopalosoma abnormis*[1] from Ceylon and Calcutta showed that the genus has been placed by various authorities among the ants, the Fossores and the Ophionid Ichneumons. Westwood doubtfully placed it among the social wasps as the remark "*quoad affinitates animum excrucians*" indicates, and Morley

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[1] *Trans. Ent. Soc.*, 1910, p 386 The Indian Museum has the female type from Calcutta.

himself thought it an Aculeate closely related to the Scoliidae. In 1917 Turner and Waterson[1] added the genus *Olixon* Cameron, which had been placed by its author in the Braconidae to the family, and remarked that the genitalia showed a very close relationship to that of the Eumenidae and was certainly derived from the same stock. Personally I am of opinion that it is an Aculeate (as the number of abdominal segments and the number of joints in the antennae of the male and female prove), in certain respects related to both the Fossores and the Diploptera. But even if we grant this we can do little more than say with that great hymenopterist, Frederick Smith :—" Place *Sibyllina* (= *Rhopalosoma*) in any group of the Hymenoptera and it will as it were stand alone ; it has little affinity that I can discover, certainly it has no strong affinity with any other known insect " It does not seem necessary to erect a new group intermediate between the Aculeates and the Parasitica for its reception, but perhaps it would be best to place it in a separate division between the Fossores and the Diploptera Or (as Morley says) have we here an " ancestral type " of Hymenopteron?

The Rhopalosomidae is widely distributed and consists at present of two genera : *Rhopalosoma* , of which two species are known, *e.g* , *R. poeyi* from Cuba and *R. abnormis* from Calcutta and Ceylon ; and *Olixon*, the type of which is *O. testaceum* Cam., from Panama Judging from the description and Cameron's figure this species seems to be abundantly different from *Rhopalosoma*.

Family EUMENIDAE.

About 80 new species and a new genus have been described since 1897. Meade-Waldo's papers on Oriental forms will be found in *Ann. Mag. Nat. Hist.*, 1910–14. The other papers are scattered and Mr. Aiyar's catalogue should be consulted. A magnificent monograph of the Eumenidae and Vespidae of the Belgian Congo has been recently published by Dr. J. Bequaert in *Bull. Amer. Mus. Nat. Hist.* XXXIX, 1918. This paper contains a classification of the diplopterous wasps with notes on specific characters and a list of Ethiopian species. Some notes on Indian species are given, the generic name of his *Icaria* been changed to *Ropalidia*, and *Rhynchium* is sunk as a subgenus of *Odynerus*.

Family VESPIDAE.

More than 30 new species have been added to the Oriental fauna. Du Buysson monographs the family in *Ann. Soc. Ent. France*, 1904. The genera and species are listed in *Genera*

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[1] *Ann. Mag. Nat. Hist.* XX, p. 101, 1917.

Insectorum, as are many other groups of the Hymenoptera ; but the articles are mostly written by foreign authors and their ideas on classification are very often not coincident with our own. In Bequaert's monograph the name of the interesting genus *Ischnogaster* is changed to *Stenogaster*, but without comment. Mr. Rao and I have been able to prove that this change should be maintained.

Families COLLETIDAE and APIDAE.

Many genera, or groups of genera, of the bees are now given family rank. Numerous new species have been described since 1897. and in a new edition of the ' Fauna " the bees alone would probably number a 1,000 or more species, in contrast with the 295 recognised in Bingham's volume. It is impossible to mention here the many papers that have been published on the group. Mr. Aiyar has listed the literature fairly completely. The most work has been done by Professor Cockerell, who writes me that the chief difficulty in dealing with the Himalayan forms is their relationship with the species found in Turkestan and adjacent localities, the descriptions of which are published in foreign languages, and the types themselves are in most cases not available, so, as Nurse found, there are uncomfortable possibilities of making synonyms. Important contributions to the subject have also been made by Strand, Friese, Nurse, Bingham, Cameron and Meade-Waldo. Friese has monographed the leaf cutting bees in *Das Tierreich*, 1911.

In concluding this review I would like to avail myself of the opportunity publicly to express my thanks to our President, Dr. N. Annandale, for the repeated favours I have received from him and for his encouragement and advice in my zoological studies. To Dr. S. W. Kemp I am also indebted for much advice and criticism while the valuable help I have received from my two friends Mr. H. Srinivasa Rao and Mr. Sydney Ribeiro must not pass unmentioned. I must also thank Professor T D. A. Cockerell, Dr. J. Bequaert, Mr. R. E. Turner, Dr. H. Brauns, Mr. T. V. Ramakrishna Aiyar, and Mr. G. R. Dutt for the unfailing courtesy I have received at their hands in the course of my studies on the Hymenoptera, while for miscellaneous entomological favours I am indebted in particular to Mr C N. Barker of the Durban Museum and to Mr T. Bainbrigge-Fletcher, the Imperial Entomologist.

5. Contributions to the History and Ethnology of North-Eastern India—III [1]

By H. E. STAPLETON, I.E.S., *Special Officer, Dacca University.*

THE ORIGIN OF THE CATHOLIC CHRISTIANS OF EASTERN BENGAL

(Together with an Appendix on the *History of the Portuguese in Eastern Bengal*, by the late DR. JAMES WISE, *Civil Surgeon of Dacca*).

(Plates 1 and 2).

Little hitherto appears to have been published regarding the origin of the Catholic Christians in Eastern Bengal who bear Portuguese names, and Dr. Wise's researches on the subject have, up to now, only been available in the extremely rare volume entitled "Notes on the Races, Castes, and Trades of Eastern Bengal," of which twelve copies were privately printed in London in 1883. Owing to the fact that these Firingis (as they are called by their Hindu and Muhammadan neighbours) bear Portuguese names it is generally supposed that they are descended from the Portuguese pirates who infested the Delta of the Ganges in the 16th and 17th centuries. The Portuguese annals constantly refer, however, to the baptism of Indians under Portuguese names, and it is noteworthy, as I pointed out in 1907 in a Monograph published in the Quinquennial Report on Education for Eastern Bengal and Assam, that their own priests do not regard these Christians as anything else but Indians. They speak usually nothing but Bengali; they are indistinguishable from Bengalis in dress and means of livelihood; and until quite recently they made no claim to be of Portuguese descent. The following notes on the names in common use amongst them attempt to deal with the subject from a point of view which, I believe, has not hitherto been discussed.

During a visit in 1913 to a school for these Christian children that is attached to the Portuguese church at Husainābād (locally pronounced Hashnābād) in the Nawābganj Thāna of Dacca District, I was struck, firstly, by the absence of Portuguese names from the register, and, secondly, by the apparent occurrence of strictly Bengāli names among the Christian boys. The Pandit, who was himself called Gabriel Gomez, explained that in addition to the Christian surnames, most of the boys have *Dāk-nāms* or customary names of address which are often recorded in the register; and even surnames are generally replaced—Welsh-fashion—by the name of their father's *bāri* (homestead). Father Menezes, the local Goanese Vicar, who was present during my inspection, further explained that as nearly all the Christians possess one or other of the four surnames—Gomez, Rozario, (Da) Costa and Rodriguez, some other nomenclature has to be adopted to prevent confusion between boys of the same name. Another reason for the use of *dāk-nāms* is that, following Muhammadan custom, boys are often called after their grandfather, and as any direct mention of the father-in-law's name by a daughter-in-law would imply lack of respect on her part, mothers are in the habit of giving their sons nick-names to avoid mention of the boy's grandfather's name. It is also significant that the Muhammadan custom of calling fathers and mothers after their first child is prevalent at Hashnābād, e g. I noticed in the records of the adjoining church that one woman was called *Moti ma* (Moti's mother).[1] Seeing that I was interested in these people, Father Menezes was good enough to call two or three intelligent men and the results of my enquiry into the names given in the school register are noted below. Except in the case of boys of the same homestead or *dāk-nām*, the order is that found in the register, and the only omissions are where names that have already been explained happen to recur. The explanations of the local Firingis have been considerably supplemented from information obtained at my request by the late Father Altenhofen C.S.C., who, until some time after the outbreak of the European war, was stationed at the Bishop of Dacca's Mission at Bandura, a village close to Hashnābād I have also availed myself freely of criticisms by educated Hindus and Muhammadans who have seen this paper in proof.

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[1] The second paper in this series is to be found in *J.A.S.B.*, Vol. VI (1910), pp. 619–648. As internal evidence will suggest to the reader the materials of the present paper were chiefly collected before the war, but the enforced delay in its publication has enabled much further information to be incorporated, especially in the historical portions of the writer's own paper and in the notes to Dr. Wise's account of the Portuguese.

1. ALBIN NIDHAN.—The latter is evidently the Bengali নির্ধন, poor.

2. DOMINGO LALMON.—*Lalmohan* is a favourite Bengal sweetmeat: but is also a common name amongst the lower classes in Eastern Bengal.

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[1] In Hindu families, besides the *dāk nām*, each person possesses a *rās-nām* or astrological name. This is kept concealed from every one from the superstitious fear that if it becomes known to an enemy, mischief will follow owing to it being possible to tell the approximate time of the owner's birth from the first letter of the name. M M. Haraprasad Shastri has recently suggested to me that one possible reason for the suppression of the Christian surnames among the Dacca Christians may be that they regard them in somewhat the same way as a Hindu does his *rās-nām*

3. DOMINGO MUKTA.—The latter is the Bengali মুক্ত 'free'; or it may be the corruption of another word meaning pearl, মুক্তা.

4 (*a*) ALBERT } AUDARBARI —Several explanations were
(*b*) ALOIS } given for the name of the boy's house, none of which can be regarded as altogether satisfactory. The first was that, the name of his great-grandfather was Adu, which was said to be a corruption of Antony. The possessive form of Adu has been corrupted in Audar Father Altenhofen later informed me that this explanation was not, in his opinion, correct, and that Adu was a corruption of Adari, 'a common Mussalman name' Educated Hindus on the other hand prefer to look upon Adu as a corruption of Adarini—a female name meaning 'beloved,' which is sometimes given to children whose predecessors have died in infancy. and who, to avert the evil eye, are deposited for a short time after birth. near a latrine, or *chitāl* (rubbish pit).

An entirely different explanation is that given by Father Menezes, viz. that Audar is short for *Havildar* after one of the boy's ancestors who served the mission as tax-collector. A more possible alternative to this latter explanation would seem to be that the name is a corruption of *Howladar*, the common term for a petty Talukdar in Eastern Bengal

ALOIS, the name of the second boy, is another form of the Christian name 'Aloysius'

5. ANTONY POCHA.—This latter word is a well-known nickname in Eastern Bengal both amongst Muhammadans and Hindus. It is simply the Bengali পচা ('sick or 'rotten') and is given to a boy whose elder brothers have died in infancy to avoid the further influence of evil spirits The Hashnābād Christians who were present all admitted that the boy's parents had previously had children who had died in infancy, but denied that they believed in evil spirits. That they do, however, is beyond question, and those who know them best agree that they often show themselves to be still as superstitious as the most ignorant among their Hindu or Muhammadan neighbours.

6. (*a*) ESCOLASTAS } PESHKĀRBARI.—Father Menezes in-
(*b*) TRINATUS } formed me that the first Christian name is a corruption of Callistus. while Trinatus is the Latinised form of *Trindade*—the Portuguese for Trinity. As for the house name the priests in the Christian settlement at Nágori (near Kaliganj on the Lakhya River) still employ a servant called a Peshkār, or Dewān, in Zamindāri matters. This man acts as a sort of confidential clerk or secretary[1] The name of the boy's house seems therefore, to show that a similar officer was once used in the Hashnābād Zemindāri. Or,

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[1] "Peshkār is one who puts up papers before a king or Court. Pewshā has the same meaning" (M.M. H. P. Shastri).

alternately, he may be descended from some immigrant from Nágori.

7. PAUL GOPAL.—The latter is a common Hindu name.

8. MARTIN GOMEZ.—This is one of the few instances found in the register, of the use of a Portuguese surname. It was found on enquiry that the boy came from Dhana Khalīfār-bārī, " the house of the cook [1] (called) Dhana." This latter is a favourite name amongst Hindu mothers, being the Bengali ধনা (rich).

9. JOSEPH NAIBBARI.—An interesting story was told me in connection with this name. The house is called after the boy's great-grandfather who was the Manager of the Hashnābād Estate in the middle of the last century. It was decided by the Mission authorities that two priests who had just been appointed to Hashnābād should manage the Mission Estate themselves. The Naib resisted, and a " Battle" took place in 1274 B.S. (1867 A.D.). Both the Naib and the priests were imprisoned in consequence of a man being killed in the fight. The priests were released after six months by the direct intervention of the Viceroy. When the Naib was subsequently let out of prison, he asked pardon from the priests and became their Dewān He was a very strongly built man, and, as a proof of his power of leaping, the marks of his two hands in black *gāb* juice are still to be seen on the roof of the anteroom of the priest's house, 11 ft. from the ground. A story is also told of how he won a piece of contested land for the Mission by taking some earth from Hashnābād by night, and placing it in the field under dispute. The next morning, standing on this earth, he swore in the presence of the rival Zemindars that to his knowledge the land on which he stood belonged to the Mission, in consequence of which it was handed over to the resident priest.

10. (*a*) MONTE } HAUS-MUSTIBARI.—Father Menezes said
(*b*) DHANA } the first name was a common Portuguese one. The second, Dhana, has already been referred to under No. 8.

'Haus' is the local name for a place where fresh water can be constantly obtained, like a pucca well, or reservoir (চৌবাচ্চা) for ablution before *namāz*. As for 'Musti,' I was informed that it was probably a corruption of *Muchi*, one of the lowest of the Hindu castes, as the family in question occupies a very low social rank among their fellow Christians (*cf.* also No. 44 *infra*); but other explanations were that it is a corruption either of *Musjid* (the entire house-name in this case suggesting that the *bārī* was originally built on the disused site of a mosque); or, less probably, of *Mutasaddi*, the title of a Treasurer or Cashier in Muslim times.

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[1] The honorific title of *Khalīfa*. which really means "Successor" is also applied to tailors. It was used in the first instance to indicate the successors of Muhammad, and is still found among the Faraizis of Eastern Bengal (a Puritanical sect of Muhammadans) as the title of their *panchāyat*. M.M. H. P. Shastri points out that by similar misuse of honorific titles cooks are called *Maharājās* in the United Provinces, and sweepers, *Mehtars* or *Jamadārs*, in Bengal.

11. AUGUSTIN MOTI —The latter is a common Hindu and Muhammadan nick-name, meaning 'Pearl.' It is used by Hindu boys and Musalman girls. It may however also be a corruption of Matthew.[1]

12. FRANCIS SHODAN —The latter is either from the Bengali (শোধন) pure. or a corruption of the common name "Madhu Sudhan."

13. JOSEPH MISTRIBARI.—The latter name does not mean, as might be thought, that one of the boy's ancestors was a carpenter, but that he is descended from a *Mestre*—the Portuguese for a catechist or sacristan.

14. (*a*) BALAI } MATBAR-BARI —The name Balai may be
(*b*) MOHAN } a contraction of the Hindu name Balaram, while Mohan is a common Hindu name. The name of the homestead shows that the family descended from a former Headman (মাতবর) of their village Nayansrī—a mile away to the west of Hashnābād.

15 MANUEL RAZA.—The latter was said to be either a corruption of the Hindu name Rajendra, or more probably a mispronunciation of Rājā (King), a name often given to an only son.

16. NIMIS SIMARBARI.—The former is either a corruption of a Latin name Nimesius or, more probably, of Nehemias. *Simār*, the local Christians considered to be a corruption of Simon. The Simārs belong mostly to the Jolā caste (*vide* No. 24 *infra*).

17. AUGUSTINE GASPAL.—The second name is said to be a corruption of the name Gaspar.

18. JOSEPH BOITA SHONARBARI.—This boy is said to be descended from a dwarf (বাইট্টা, *baitta*) whose *dāk-nām* was *shonā* (সোনা golden).

19. (*a*) ASSIS } IMAMNAGAR.—Assis may either refer
(*b*) JANU } to St. Francis d' Assisi or is a cor-
(*c*) LAURENCE } ruption of the Muhammadan name Aziz.[2] Janu is said to be a Muhammadan name and not, as might be supposed, a corruption of John The village name *Imāmnagar*

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[1] Other corruptions of European names found among these Christians are: Giri—Gregory; Tufani—Stephen; Bintu—Benedictus: Anis—Ernest; and Ambo—Ambrose. Tufani is, however, a name constantly found amongst Namasudras, and may only refer to the fact that the person who bears it was born during a storm.

[2] Father Hosten prefers the first explanation of Assis. He writes: "Assis should be considered as a Portuguese form of 'de Assisi.' There was a Father d' Assis at the Boytakhana Church, Calcutta, for many years"

also seems to point to a Muhammadan origin for this family. It is situated on the opposite side of the small river Ichhamati to Hashnābād

20 (*a*) SHUKU
(*b*) NAGAR
(*c*) NALMON } SHIKDARBARI.—Shuku is from the Bengali সুখ, happiness; Nagar is said to be a corruption of Nagen, or it may simply mean 'town' as in *Nagarbashi*—a fairly common name amongst low caste Hindus;[1] and Nalmon is a corruption of Lalmohan (*vide* No. 2). I was told that the homestead name indicates that the boys are descended from the petty village pleader who used to appear in disputes before the priests, and that the family came from Malikanda, near Narisha, before it was cut away by the river. The ancestors of the family held good positions when indigo was still largely grown in Eastern Bengal It may, however, be noted here that in Bikrampur *Shikdār* is the usual name of the *nafrs* (or former slaves), who now hold land from Zemindārs on condition that they perform certain menial duties when required, e.g. they clean the cooking utensils of the household, and at weddings they have to carry the bridegroom and bride in procession.[2]

21 SENNY BILU-SADU-BARI —This extraodinary name appears to mean that the boy, to avoid ill-luck, was called by his parents after the Hindu planet Sani (শনি Saturn), and that he is a son of Bilu who was either descended from a Hindu Sanyasi (সাধু)—this word in turn is derived from *Sādhan* (intensive meditation) —or whose father was called Sadu—a corruption of the Muhammadan name Saadat Ali It was suggested that Bilu is the equivalent of William, but Bilu is a common Hindu and Muhammadan name. It is a corruption of *Bilva*, the *Bel* tree which is regarded as sacred by Hindus, as it is supposed to be the favourite tree of Mahadeva (Siva) · no Hindu *pujā* can be performed without its leaves

In this and other similar cases the Christians present freely admitted that they were descended from Bengalis, and in illustration of how Portuguese names do not imply descent, I was told the following story —

In 1912, some objection was made by the Educational authorities to admitting the claims of certain boys from Golla, near Hashnābād (who had obtained admission on the strength of their surnames to a European School) to be of Portuguese descent. The rumour at once spread in the Christian villages that all but those whose surname was 'Gomez' had been accepted, the reason being that this name is regarded by the Firingis as the usual synonym for 'native Christian.'[1]

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[1] If pronounced Nāgar, it means 'Lover', as in Sri Krishna's name "Nāgar Syām Rai"

[2] This is another instance of the sarcastic use of high titles that has been previously referred to in the note on No 8 *supra* In the time of Muslim rule in Bengal, the officers in charge of Revenue divisions termed *Mahalls* were given the title of *Shiqdār*, *cf.* Blockmann, *Geography and History of Bengal, J A S B.*, 1873. pp. 214 & 273

22. GOLAP SHARDARBARI.—Golap is a Hindu name meaning 'Rose.' I was told at the time that Shardārbārī meant that the family is descended from a leader of the village Paiks, the militia of the middle ages in Bengal; but I have subsequently learnt that the title of S̲hardār was formerly given to the Headman or President of the guild of 'Pobres' (undertakers) or Church servants in Calcutta. This title of honour is still used by descendants of these men in their native villages.

I may add that the Church at Bandura is sometimes referred to in the *Catholic Herald* about the middle of the 19th century as the 'Pobries' Church, presumably because it was from this neighbourhood that Calcutta then drew "its inexhaustible stock of cooks and 'pobrys'" (*idem*, Dec. 15, 1865).

23. MUKTA KALU SHIKARIBARI.—The first name has already been mentioned under No. 3. I was told that the boy's grandfather, who was called Kālu ("Blackamoor") was a hunter of pigs on the Faridpur *chars* (sand dunes). Another homestead in the vicinity is also known as Bāgh S̲hikārībārī, "The house of the Tiger hunter." Kalu is a name used both by Hindus and Muhammadans, and in the case of Hindus is an abbreviated form of Kāli Mohan ("the charmer of Kāli," i.e. Siva). It was suggested, however, by one of my informants that among the Christians it might also be a corruption of Carolus.

24. ADU DAURIJOLA-BARI.—For *Adu* cf No. 4 above. *Dauri* at first was said to be a Muhammadan name connected, possibly, with "Darī," beard. It is, however, a common name among the lower Hindu castes, and as the word is used as an adjective in the sense of 'wet and rainy' it may refer to the boy being born on a stormy day. Another explanation is that it is derived from the Bengali দাউরা 'a man who does not stick to his word,' 'an untrustworthy person.' Jolā means that this family is descended from Musalman weavers (জোলা).

25 (*a*) MANGAL } PARAMANIKBARI.—Mangal is a Bengali
(*b*) JANI } name used both by Hindus and Muhammadans, and means 'fortunate.' Jani is a Muhammadan name meaning 'beloved.' Paramanik probably shows that the family is descended from a Hindu barber, but like S̲hiqdār (*vide* No 20 *supra*), it is an honorific title now adopted as a family name in several castes, e.g. the Suvarnabaniks

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[1] I add here a note by Father Altenhofen on the precise local meaning of the word 'Firingi': "Mussalmans call any Christian 'Firingi': but as the native Christians are black compared with Europeans, they are called sometimes 'Kālā Firingis.' In the Muffusil they are simply called Firingis, because there are no white Christians there. That Firingi is more the name for 'Christian' than 'European' is shown by the expression still in use *Firingi Kara* = 'to baptise'"

26. JOSEPH ATAI KANTUBARI.—Kantu is said to be a Musalman name (? Kāndu). Atāī signifies that the boy is descended from a man who was an eight months' child.

27. POCHA KHAITABARI.—For Pocha *vide* No. 5. Khaita is the Bengali (খাইটা), a dwarf Locally it seems to be used, like Pocha, as a charm against the evil eye

28. FELU KOILABARI.—Felu is a Musalman name Koila is a nickname meaning 'charcoal' or 'a coal-black person' (*cf.* No. 23).

29. MARTIN SHUMASTIBARI.—The boy's homestead is said to be a large one and the name may therefore mean simply 'big house,' (Bengali সমস্ত).

30. JOHN TURKULI.—Turkuli was alternately said either to be a Musalman name; or 'a big worm that lives in mud' My Musalman servants did not however recognise either, nor had the local Sub-Inspector of Schools ever heard before of such a word as Turkuli. Father Altenhofen subsequently wrote: "The question of Turkuli I solved simply by telling the school children to bring me that 'worm.' I got a number of a very common insect, which always flies round the lamp in the evening, especially in January and February."

31. MOTI TALGASIYABARI.—For Moti *vide* No. 11. The homestead name signifies that formerly a big palm tree (তাল গাছ Tāl gāch) stood near it. A similar name is seen in the next boy in the register Laurence Tetulgasiya-bari, whose home is near a big tamarind tree (তেঁতুল গাছ).

32 KANAI BHOGAIRBARI.—Kanai is a typical Hindu name, being one of the names of Krishna. Bhogai was said to be a corruption of Bhagirath, the name of a Hindu ancestor.

33. FELU KHALPARIABARI.—Felu is a Musalman name *vide* No. 28. Khālpāria bārī is so called because the homestead is situated on the bank (*pār*) of a *Khāl* (water channel).

34. JUMA DUNDARBARI —The first name is probably a Musalman name, though if it represents a Christian name it stands for James. The Christians suggested at the time of my inspection of the register that *Dunda* was from the word meaning the scoop (made from a hollowed-out palm tree) that is employed to lift water from one field to another (ডোঙ *donda*). I afterwards learnt that *dunda* is the local name for a quarrelsome woman. As the joint family system is still observed by these Christians, there are often many women in one *bārī*, and if they habitually quarrel, neighbours soon get to call the house *Dundā-bārī*, the *bārī* of the quarrelling women.

35. SHUKU NAIRABARI.—For Shuku *vide* No. 20(*a*). Nairabari is said to be derived from Nūr, a Musalman name.

36. FRANCIS DAYAL DUKHAIBARI.—The boy's grandfather who was called Dukhai (from দুঃখ sorrow) is said to have become a disciple of a Fakir and when he returned to the Christian fold, the priest is said to have suffixed to his name

Dayal (দয়াল) meaning "the too-broad-minded one" by way of punishment.

37. NIDAN BAKTABARI.—For Nidan *vide* No. 1. Bakta is the Bengali ভক্ত, "Religious." Father Menezes was inclined to agree with Dr. Wise's remark that it was a name originally "given to the Secretaries who also acted as catechists in the absence of the Pastor." For further information on *Bhaktas vide* p. 41 of the reprint of Dr. Wise's paper, and note (2) on the same page.

38. SHUKAI DACAITBARI.—The first is a Hindu pet name from the same root as *Shuku*, *vide* No. 20(*a*). As regards the homestead name, the Christians declared that the boy's ancestor was not a dacoit, but that his ancestor was given the name because he killed several buffaloes who strayed on to his land In Bikrampur generally, *Dacait* is colloquially used for a rash or headstrong man.

39. JOSEPH KANSHABARI.—Kansha was said to be the Bengali "খাঞ্চা" "*Khanchā*," a large wooden plate; but it seemed to me at the time more likely to mean that the ancestors of this family were braziers (কাংশ, brass) Subsequently I learnt that the true derivation was quite different. An ancestress of the family had given birth prematurely to a child on the edge of the slope (Kānsẖā, কান্সা) of the earthen mound on which the house was erected. The child was given the name Kāusẖā with reference to this incident, and it has been kept by his descendants.

40. GULU DALIBARI.—Gulu is a Musalman name but the Christians said that it is a corruption of Golāp, *vide* No. 22. The name of the homestead would appear to imply that the boy's ancestor was a shield-bearer, (ঢালি, *Dhāli*); especially as a leather shield and some old *Rāmdaos* (swords) still hang in the anteroom of the Priest's house and are taken out on Good Friday for use in the procession on that day. The Christians, however, asserted that the name showed that the boy was descended from a Dāli (ডালি), the local name for a superior kind of sweeper who supplies plantain leaves for a feast, and clears away the refuse afterwards. In Bikrampur, Dāli is identified with *Beldār* (বেলদার), or Muhammadan sweeper.

41. ANTONY AUNJU.—Father Menezes informed me that the latter was a corruption of the Portuguese name Dos Anjos.

42. FELU KARIKARBARI.—For Felu, *vide* No. 28. The homestead name shows that the boy is descended from a Jolā or Musalman weaver. Kārikar is a title used by men of this caste.

43. MUKTA DARI SHANERBARI.—For Mukta, see No. 3. Dari Shaner was explained by the Christians as being derived from Darikandi (a village name); but it appears more likely to be a compound from the word *Dauri* that occurs in No. 24; and *Shonā*, *vide* No. 18.

44. Paul Musi Matbarbari.—Although the Christians denied the derivation, the name Musimatbar appears to show that the boy is descended from a Headman of the *Muchi* or cobbler caste. The appellation Musi (Muchi) may, however, be derived from the low-caste nickname given to a child by parents, whose previous children have died, to ward off the effect of the evil eye. The procedure is to sell the child to a very low caste man for an insignificant sum—even a broken cowrie will do—and then to redeem it for a much larger amount, say Rs. 2. Once this is done, and the child given the name of the low caste purchaser, the superstitious parents believe that the child will survive, the evil spirits not caring to waste their time in harming any one of apparently such a low caste. In this case, therefore, a Muchi may have been the purchaser of the child, while the child's descendants probably retained the name from similar motives

Usually, however, in Hindu circles, the parents do not go so far as to change the family name, but only prefix a name indicating the price for which the child was sold, e.g. 'Tinkari' Banerji.

Whatever be the true story, the family to which this boy belongs ranks among the lowest grades recognised by Firingis and finds it difficult to obtain bridegrooms for its girls.

45. Manik Fakirbari.—This is an altogether Hindu name Mānik means a Jewel (ruby), and the original ancestor of the family appears to have been a converted Fakir

46. Moti Kala-Bola.—This would also appear to be an entirely Hindu name. Kālā-bolā is said to be a corruption of Kalu Bholānāth; but may also come from Kalā Balarām, the former a name of Krishna, and the latter that of his elder brother.

47. Nagar Gayanbari.—This again is altogether a Muhammadan name. The homestead name shows that the family is descended from Musalman singers (গায়ক).

48 (*a*) Shona } Bobarbari.—For the two *dāk-nāms* see
(*b*) Jani } Nos. 18 and 25 (*b*) respectively. One of their ancestors was either dumb (Bengali বোবা) or received the nickname Boba.

49. Shodan Oibarbari.—For Shodan *vide* No. 12. Oiba is said to be a corruption of Habibulla and indicates descent from a Muhammadan of that name

50. Simon Domingo.—This shows that the boy Simon is the grandson of a Christian called Domingo.

51. Francis Dagarbari.—His grandfather was called by the Musalman name Dāgu which may be derived from the Bengali দাগা, to scratch.

This concludes the list of names found in the school register; but the following additional names that are in use in the locality may also be briefly referred to. They are chiefly selected from the Parish Registers which are very excellently kept and deserve more careful study than I was able to give to them during my short stay at Hashnābād.

52. **Amrabaziyia Bari.**—This is said to be derived from Āmīrābād, a Bikrampur village near Narisha, which has now been cut away by the Padma. When this happened the people migrated to Hashnābād. The name of the village first appears in the Hashnābād Registers in 1780, and in 1844 there were still 25 Christian families there. It is evidently a different place from the 'Amidabad' mentioned by Rennell in his Journal as the northernmost of the islands in the Megna, east of Rajabari (*Memoirs A.S.B.*, Vol. III, No. 3, 1910, p. 38). In proof of the dialectic change of a terminal 'd' to 'z' (or 'j') in Dacca District, I may mention that when subsequently visiting a girls' school under P.O. Āmirābād, Thana Raipura, I noticed that the girls wrote the name of the post office as আমিরাবাজ.

53. **Sitabari.**—This is a nickname given to a man who was so lazy that he would not plant onions properly, one by one, but scattered them over the field and then went home, expecting that they would grow. It is from the Bengali ছিট' *Chhita* (pronounced *sita*), a careless sower

54. **Mulkhar Bari.**—This is named after Muluk Chand an ancestor of a family called Rozario. The homestead is otherwise known as *Jaishāriyār bārī* as Muluk Chand's father came from Jessore. These names at first suggested to me the possibility that this family might be connected with the son of the Zemindār of Busnā one of the Twelve Bhuiyas of Bengal, who was the chief agent in the success of the Augustinian Mission in the 17th century. Under the name of Don Antonio del Rosario he had joint charge in 1679 of the Parish of Noricol. This place was a little to the east of the present Janjira on the southern bank of the Padma. Don Antonio is not, however, recorded as having had any children (though he had a wife) and he probably ended his life as a monk at Nāgori (*vide* note 1, p 4, *infra*). Some Christians seem to have remained behind at Noricol after the exodus to Nāgori in 1695, and it is said that it was their migration to Hashnābād that led to the erection of the church at Hashnābād.[1]

Another homestead is called Bhuyarbāri which also suggested, at first sight, some connection with the former Twelve Lords of Bengal. On the other hand a simpler explanation might very well be that the original owner was a taluqdār, as, in Bikrampur, cultivators still address their immediate landlord as *Bhuiya*. Further enquiries showed as a matter of fact that the original ancestor of the family was a Muhammadan landowner called Muhammad Ali who lived at Dapari (near Nawabganj) and Masurikhola (near the western mouth of the Buriganga) about seven generations ago, i.e. *c.* 1700 A.D. The first Christian of the family settled in Bandura.

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[1] Rennell notes in his Journal on the 14th February, 1765 "The 14th in ye afternoon passed Luricule which is situated on the south side of the [Mulfatganj] creek. Luricule, once a remarkable village, lies almost half way betwixt ye Ganges and Megna, is about 28 miles S.½W. from Dacca and 3 ESE from Rajanagore. Here are ye ruins of a Portuguese Church and of many Brick Houses." (*Memoirs A.S.B.*, III, p. 39) It would be interesting to discover what led the Christians to desert their settlement. The ruined buildings remained visible till 1880 when the spot was swept away by the river (*idem*, p 135)

55. PALTAN SHIKDARBARI.—No. 20 may be seen in connection with the homestead name. The first name indicates that some member of the family was a soldier, employed in guarding the old military road from Calcutta to Dacca. After crossing the Padma near Moinat steamer station, this road reaches the Ichhamati River at Nawabganj. There are still numerous "Paltans" in the villages of the Nawabganj Thana.

56. FOITABAZIYA SHONARBARI.—This is called after a man Shona (*vide* No. 18) who came from Fathābād, the old name for the present districts of Barisal and Faridpur. The Bengali poet Vijay Gupta mentions "Muluk Fateābād" in 1494 A.D. (*cf.* Dinesh Chandra Sen—"History of Bengali Language and Literature," page 279; also *Dacca Review*, Notes and Queries No III. March. 1913, p. 457).

57. TATKA BASI BARI.—The first *dāk-nām* of the man was *Bāsī* (বাসী), which means "stale." As however he was in the habit of talking too much at meetings, he was given an additional nickname *Tātkā* (টাট্কা) which means "fresh."[1] The name is in phonetic accordance with certain Hindu names, e.g. Nadīyārbāsī (নদীয়ারবাসী) inhabitant of Nadia; and Mohanbāsī (মোহনবাসী, melodious flute).

58. (*a*) ALI } COSTA.—These two names supply an ex-
(*b*) MINGA } ample of a Muhammadan name being used in the same family as a Portuguese name, Minga being said to be a corruption of Domingo. Ali may however be short for Ali Chand, the usual Firingi corruption of Alexander.

59. CHANDI AKALIABARI.—A former owner of the homestead was originally called Akalia because he was born in famine time. When, afterwards, he went to Calcutta, as many of the Christians do, to serve as a cook, he worked with Maghs, amongst whom he was known as Chandi. The name stuck to him on his return.

60. (*a*) RANI BADARBARI } The first two supply instances
(*b*) JAMAILARBARI } of Muhammadan names;
(*c*) HIRARBARI } while Hira is the Hindu name Hiralal. Rānī Badar refers to a man called Badar (after Pir

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[1] This explanation seems rather far-fetched.

Badar, one of the Patron saints of boatmen. whose shrine is at Chittagong). The man's mother was so fair that she was admiringly called Rānī. Jamail is a corruption of the Musalman name Jamāl.

These sixty items appear to show fairly conclusively that in the great majority of instances the Christians of Hashnābād are not descended from Portuguese at all but are merely converts from Hinduism and Islām. Additional proof of this is afforded by the fact that all the Christians near Hashnābād belong to one or other of four sub-castes between which little intermarriage has hitherto taken place. These, in approximate order of social standing, are :—

(1) Chāsha (cultivators);
(2) Jolā or Jolahā (weavers);
(3) Nikā (descendants of a remarried widow);
(4) Chāṛāl (Chaṇḍāls, who now call themselves Namasudras).

The first two chiefly claim to be of Mussalman descent though some of the Jola class are known to have been Hindu in origin. Father Altenhofen informed me in 1913 that the proportion of Musalman to Hindu Feringis at Hashnābād and the neighbouring Dacca Mission station of Gollā is roughly 3 to 1. Though in no way superior in character to the Christians of Hindu descent, the Musalman Chasha Christians consider themselves much superior in social status and only for a third or fourth marriage, if no other woman can be obtained, will one of them condescend to marry a Hindu Chasha Christian. Jolās marry much more frequently with Chārāl Feringis; but absolutely no marriage is said to occur between the Nikās and other Christian castes. The name Chāsha suggests that even this class may have been originally Chasi Kaibartta (the Hindu caste which now prefers to call itself Mahishya) and that before Hashnābād Kaibarttas became Christian there was an intermediate stage of Muhammadanism. The inclusion of persons of both Musalman and Hindu descent among the Christian Jolās also points to the accuracy of Dr Wise's remark that even the Muhammadan Jolahās were probably once low caste Hindus, though the classification adopted by the Hashnābād Christians seem to indicate that their original caste must have been of somewhat higher status than Namasudras.

All this tends to support the evidences of history in affirming that the Portuguese missionaries of the 16th and 17th centuries did not chiefly deal, as Dr. Wise seems to have concluded, with the descendants of Portuguese, but that their main work was to minister to converts from both the Muhammadan and Hindu fold. Prior to the advent of the British, Musalman converts were compelled to remain 'Hidden Christians.' as open conversion involved the capital penalty both for convert and missionary[1] and it is therefore probable that these early missionaries obtained their cheif successes amongst the lowest Hindu castes, just as at the present day, Christianity in Bengal is only making headway among the Namasudras, and such semi-Hinduised castes of as the Koch-Mandai of Bhowal. With extremely few exceptions, none of the existing Catholics, who reside in Mofussil villages of Eastern Bengal, make any claim to be of European descent; they all freely admit that they are descended from either Muhammadans or Hindus. The priests unanimously agree that their flocks still follow the same customs as their Hindu and Muhammadan neighbours, and are only slowly dropping those observances that are not in accordance with Christian teaching; while the emphasis that is still laid upon caste bears a strong resemblance to the practices that the missionaries of the latter half of the 17th century so bitterly complained of in the case of the wholly Indian converts of Antonio del Rozario. We thus arrive at the conclusion that the Catholics of Dacca District who have formed the subject of this paper are Indians pure and simple; and but for their Portuguese names and the occasional use of articles of European dress—both of which are sufficiently accounted for by the prolonged influence of Portuguese Catholicism on Eastern Bengal—they would probably never dream of alleging that they have any admixture of European blood.

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[1] *Cf.* Josson. Historie de la Mission du Bengale de la Compagnie de Jésus *Missions Belges* 1914, pp. 6 and 7 (referring to Dacca and Bhowal about 1750) For proof of the firmness with which caste and other Hindu practices were retained by Don Antonio's converts from Hinduism at an earlier date, *cf.* Father M A. Santucci's letter to the Rt. Rev. Father F. Queyroz, Patriarch of Ethiopia, dated January 1683—the portions reprinted by Father Hosten in the *Catholic Herald of India* for Nov. 21st, 1917, p. 792; Nov. 28th, p. 813, and Dec. 12th, pp. 848–9. From these it is clear that the Hindu converts still considered themselves to be Hindus

A story told me recently by M.M. Haraprasad Shastri, after reading this paper, illustrates very clearly from his own experience the power still exercised by caste in the case of other races in North-Eastern India. During the great Orissa famine of 1866, missionaries assisted in the work of relief and incidentally made many converts. They followed up the work of conversion by making provision for the English education of the converts' children: and ultimately a Brahmin's son passed the B.A. To celebrate his success he gave his friends a feast at which chicken curry was served. Hearing this his father became very angry. He said: " There was famine and food was not available; the Padri Saheb gave us food and made us Christians. What if we *were* made Christians? Did we give up our caste? Are we like Bengali Christians, eating chicken and beef and giving up our caste?"

I quote the story below in all the vividness of the original Bengali:—

১৮৬৬ সালে উড়িষায় আকাল হয়। লোকে খাইতে পায় না—অনেকে মারা যায়। মিশনারিরা অনেককে খাইতে দেয় ও তাহাদের খ্রীষ্টধর্ম্মে দীক্ষিত করে। তাঁহারা ছেলেদেরও ইংরাজী শিক্ষার উপায় করিয়া দেন। একটী ব্রাহ্মণের ছেলে বি, এ, পাস করে। সে তাহার বন্ধু বান্ধবকে ফীষ্ট দেয়। সে ফীষ্টে মুরগীর মাংস বাবহার হয়।

এই কথা শুনি তাহার পিতা বডই চটিয়া যান। তিনি বলেন, " আকাল হইল, খাতি না পাইল, পাদরী সাহেব খাতি দিন। কিরস্তান করিল—কিরস্তান হইল ত কি হইল। মু কি জাতি দিন। মু কি বাঙ্গালী কিরস্তান যে মুরগী খাইব, গরু খাইব, জাতি দিব।"

I add as an Appendix (I) the introductory note that is found in a register belonging to the Hashnābād Mission, in which some account is given of the origin of the Mission. As it was only written in 1880, it merely embodies current tradition, but the opening sentence is of some importance in confirming the argument of this paper that the Portuguese Missions in the interior of Bengal were to converts, and not to descendants of Portuguese. No earlier documentary evidence regarding the history of the Mission appears to be available at Hashnābād.

I also reprint as a second Appendix (II) Dr. Wise's historical essay on the Portuguese of Eastern Bengal that was mentioned at the beginning of this paper and to which reference has been made more than once in subsequent pages. This I do, not only to rescue it from the ill-deserved obscurity in which it has hitherto remained, but also because, in addition to supplying an excellent summary of the early history of the Portuguese in Bengal, the author is inclined to adopt a somewhat different view of the origin of the Catholic Christians from the one I have been led to by the facts stated in this paper. It is reprinted from a copy of Dr. Wise's volume on the Tribes and Castes of Eastern Bengal that was presented to me by the late Mr. Harinath De I E S., when I first came to Dacca in 1905, and which has since been my constant guide in all matters of caste Full notes have been added to bring the paper up to date, and to correct any inaccuracies that crept into Dr. Wise's account, and for these I have to express my special indebtedness to the Rev. Father H. Hosten, S.J.

A third Appendix has been added which summarises the work of the Propaganda Mission in Eastern Bengal. The figures, by comparison with those quoted by Dr. Wise, will furnish some indication of the progress of the Mission during the last forty five years.

I cannot bring this paper to a close without a few words of further acknowledgment of the help that was so freely given me in 1913 15 by the late Father Altenhofen, C.S.C., when the materials on which the paper is based were being gathered and sifted. Just as the present edition of Dr. Wise's remarkable essay owes any merit it may possess to the generous assistance I have received from Father Hosten, similarly I would have hesitated to publish my notes on the origin of the Catholic Christians of Hashnābād, if Father Altenhofen had not been available to supply the many additional details of custom that only one living in the vicinity of Hashnābād could ascertain Born an Alsatian, with his home close to "the starting point of the German army marching upon Longwy" (letter of Aug. 10th, 1914) he came out to India in October, 1907, and from

1911 to February 1915, he worked at Bandura and the neighbouring mission at Golla. Had he lived, there is no doubt that Father Altenhofen would ultimately have published much useful work on the origin and customs of the villagers amongst whom he laboured; but this was not to be. For some time after the outbreak of the war, he was preserved from internment by the intervention of friends who stood surety for him. When at last this was no longer permitted, and he was about to be sent to Ahmednagar, he fell seriously ill and after an operation in the Mitford Hospital, Dacca, he died on November 23rd, 1915. He is buried in the Catholic church at Tezgáon. Requiescat in pace!

APPENDIX I.

"ABOUT THE CATHOLIC MISSION AT HASHNABAD.'

(*A prefatory note in one of the Mission Registers: written about* 1880.)

It is more than 300 years ago that some natives of different parts of Bengal were converted to the Roman Catholic Religion through the efforts of the Portuguese missionaries.

Rev. Fr. Raphael[1] was the first priest who came to Hashnabad, and establishing himself in various places, converted a good number of people to his religion at Noricul, now attached to Furredpore, and thence he passed to Hashnabad, Gollah, Malikanda, Solepore, Ikrashi and Bandurah of the District of Dacca. Dos Mahomed Osman of Hashnabad, being enraged at the conversions of his tenants to Christianity, ordered that Fr. Raphael should be arrested and his hands and feet being tied up should be thrown into a ditch or well. He defied the new converts saying: "If your priest is a true minister of Almighty God let us see whether he dies or not." And after a long time hoping Fr. Raphael was already dead, he ordered the Christians to take out and bury him, but to the great glory of God, to the extreme joy of the Christians, to the immense confusion of [the] heathens, Fr. Raphael was taken out alive and found unhurt. Then Dos Mahamed Osman asked pardon of Fr. Raphael and offered some landed properties for [the] establishing of his mission and his disciples.

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[1] As Father Hosten has pointed out to me, the Rev. Father Raphael who is here mentioned, is probably the Fray Raphael das Anjos who was priest at Padri Sibpur in and before the year 1764 (*cf.* Beveridge, *Backarganj*, pp. 106–109). This is also confirmed by the writer's statement——which he did not notice contradicted the date of 300 years ago for the foundation of the Mission at Hashnābād—that the Muhammadan Zemindar, Dost Muhammad Usman, sold his property to Friar Raphael 'when the English dominion was established in India.' According to the *Annuario da Archid de Goa*, 1897, pp. 193 and 194 (quoted by Father Hosten in his notes to Archdeacon W. K. Firminger's translation of Père Barbier's letter of 1723—*Bengal: Past and Present*, Oct.-Nov., 1910), the Hashnābād Mission dates from 1777 so that Fray Raphael would appear to have conducted his missionary labours in the Dacca District subsequent to founding the Christian settlement at Padri Sibpur. Further confirmation to the date of 1777 is furnished by the Church registers at Hashnābād, the first entries having been made in 1780. In view of Rennell's statement in 1765 that the church at Noricul was already in ruins (*vide supra*, p. 14, Note), I am inclined to doubt this local tradition of the original Christian colonists of Hashnābād having come from Noricul or of Father Raphael's alleged connection with that place.

The *touzi* number in the Dacca collectorate office of the estate held by the Portuguese Mission of Hashnābād is No. 1288 Taluk Padrean: but no reference to Dost Muhammad can be found in the collectorate papers regarding this estate.

Hence Fr. Raphael built his church about 300 years ago, converted many more people, and brought for missionary work another priest named Fr. John When the English dominion was established in India, Dos Mahomed sold his Zemindary to Fr. Raphael and went away. The official documents of the Zemindary exist in the name of Dos Mahomed Osman. There is no difference between the Christians with regard to their social intercourse and they constitute and consider themselves as one family and they make a weak distinction in respect to marriages only; those who descend from Mohamedans, weavers, farmers, etc., want to have marriage with those of the respective origin; but at present this distinction is getting vanished owing to many mixed marriages. All documents of the former times are destroyed by white ants.

APPENDIX II.

PORTUGUESE IN EASTERN BENGAL.

By the late Dr James Wise, M.D., of Dacca.

[p. 409] "The first Portugall," as far as Antonio Galvam knew,[1] "which drunke of the River Ganges was a knight, called J. Coello." In 1516, Fernando Perez de Andrada was sent with a letter to him, but the credit of having discovered and observed the country is due to Don John de Silveira, who was commissioned in 1518 to negotiate with the King of Bengal. The embassy was hospitably received by the governor of "Chatigan," but a quarrel arose, and though speedily quelled, broke out again, and with great difficulty a treaty was concluded. The governor, however, was only dissembling. The Portuguese vessels were attacked by a swarm of war boats, which they repulsed, but were obliged to retire to Ceylon in a very crippled state.[1]

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[1] "The Discoveries of the World" Reprinted by the Hakluyt Society, p. 131.

[According to Père H. Josson *op. cit.* August 1913, p. 285) Coello was sent by d'Andrade to the Court of Bengal—then under Sultan Husain Shah. The Portuguese Viceroy of India at the time was the famous Alphonso Albuquerque (1509–1515): and he was succeeded by Lopez Suarez. H.E.S.]

Another account is, that Silveira, being sent to establish a factory in Bengal, met with a most unfriendly reception owing to a rumour that his fleet was a piratical one. The expedition passed the winter amid great hardships, especially from famine, and the crews would have perished miserably but for the opportune arrival of another flotilla under Juan Coello.[2]

It is in connection with this expedition that Dacca is first mentioned in history. Fonseca refers to a governor of the city of "Daracca." and Castanheda styles him "do Señor da Cidade Darraçao."[3]

In 1527 a Portuguese vessel was wrecked on the coast of Chakaria, south of Chatigan. The crew on reaching dry land were ill-treated by the inhabitants and one of them killed [4]

As early as 1528 the Emperor Baber casually mentions that the Bengalis were famous for their knowledge of artillery, acquired, there is reason for believing, from the Portuguese. A few years later Mahmúd Sháh, king of Bengal, hard pressed by the Afgháns under Shír Sháh, applied for aid to the Viceroy at Goa [Nunode Cuna]. In 1537 a small force was sent under Martin Alfonso de [p 410] Melo, but before it could reach Gaur, that city had been taken by the Afgháns. The Portuguese soldiers were at first ill-used, but their bravery in holding the pass of Taliágarh gained them better treatment, and permission was granted to build a fort at Chatigan.

The Portuguese had no established government, settlement, or fortress in Bengal at the end of the sixteenth century. As a writer remarks, having no laws, no police, and no religion they lived like the natives. A lucrative and thriving trade, however, was carried on at Hughli, or, as it was then called, Golin and Porto Pequêno, as well as at Chatigan, or Porto Grande Furthermore, numerous Portuguese adventurers resided with their families in Bandels[5] trading in salt and cotton goods, which were shipped in "Foists," or Jaleas, to Dianga,[6] and the

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[1] "Osorio da Fonseca," p. 412; "Lopez de Castanheda," Lib. iv, cc 38, 39

[2] "Faria-y Sousa", i, 220

[3] "Fonseca," Lib. xi, 413; 'Castanheda", *op. cit.* [Father Hosten notes that Dr. Wise is at fault in saying that this is the first mention of Dacca. The reference is to Arakan—Racaõ in Portuguese.]

[4] "Histoire Générale des Voyages," 1, 141.

[5] From Persian "Bandar," an emporium, mart.

[6] The site of Dianga is still doubtful. Du Jarric (Liv. vi) says it is "une ville sise en ce port de Chatigam, ou les nefs qui viennent de l'Inde, mouillent l'anchre." Van der Heiden describes it as "eene Stadt in de haven van Chatigam."

[Dianga is near the mouth of the Karnafuli River, on the left bank.

Portuguese settlements on the Malabar Coast. Others took service with native princes and fought bravely against Mughal and Afghán These mercenaries were regarded as rebels (levantádos del rey), because they neither assisted their countrymen nor paid tribute to the Goa Government. Their character was infamous. The majority was composed of military deserters, ruined traders, renegade priests, and spendthrifts of all ranks and professions, who, resorting to Bengal, led scandalous lives, without any religion or law. The dishonour brought on the Christian name forced the Church to interfere and at the end of 1597 [May, 1598] a deputation, consisting of two Jesuit fathers from Goa and one from Dianga, was sent by the Archbishop of Goa to preach the gospel in Bengal and minister to the Portuguese settled there [1]

In 1598, the fathers arrived at Hughli, where many Portuguese and native Christians resided. The number of professing Christians far exceeded what was anticipated, and at "Ciandecan" or Jessore, the mission baptised two hundred free and bond men. The toleration of the native rulers and officials is most surprising. When the fathers left Hughli, after founding a school and an hospital, the first in Bengal, the Munçif did not exact the customary fees. At "Ciandecan" they were given a piece of land rent free on which to build a church, and got permission to preach and convert at pleasure. At Sripur the same liberality was shown. Six hundred pieces of gold were

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Ruins of a church, etc., are said to be still visible there Three miles to the north on the opposite bank, half way to the present town of Chittagong is Angaracole, which had also an Augustinian Church when Manrique visited Chittagong in 1630 In 1843, Father Barbe, the Vicar of Chittagong, wrote to the *Bengal Catholic Herald* (Vol V, pp 268–271) that 12 Christian families still lived at Deang; and that he had been told "by a Mosulman, who is about 1 0 years old, that he recollected the time when some of the villages close to that place were all inhabited by Christians. Since that epoch, some families are gone to Tipperah, some to Neacolly (Noakhali) and the remainder are in different places of the Chittagong District" (*cf.* Father Hosten's notes to Père Barbier's letter (*loc. cit*, pp. 20 and 21) H.E S.]

[1] [There were, however, priests in Bengal proper before 1597, to whose ministrations the occurrence of the Christians referred to in the next paragraph was presumably due. Jesuits from Goa (Antonio Vaz and Pedro Dias) are mentioned in 1576 as having visited Bengal. Another priest of Satgaon, called Julian Pereira, journeyed to the Court of Akbar in 1578; and the impression he made on the Mughal Emperor resulted in the invitation to Fathpur Sikri in 1580 of Aquaviva, Henriquez and Montserrate from Goa. (Josson, *op. cit.*, pp. 289, 290 and 322). The names of the two priests (not three, as Dr. Wise states), sent by Father Nicolas Pimenta, Visitor of the Society of Jesus, to Bengal from Goa in 1598 were Francis Fernandez and Dominic Sosa. They were joined in the following year by Andrew Bowes and Melchior de Fonseca, but Father Hosten doubts whether either of the latter came from Dianga. Fernandez died in prison at Chittagong in 1602 from ill treatment at the hands of the Arrakanese King. (Josson, *op. cit.*, pp. 290 and 291, Beveridge, *Bakarganj*, pp 28–34.) H.E.S]

assigned as an annual contribution; while at Baklá the salary of two priests was paid by the Rája.

[p. 411.] In 1601, the Jesuits had two missions in Eastern Bengal, one at Jessore, the other at Chatigan Owing, however, to disturbances, the Jesuit fathers were withdrawn, and the Church of Eastern Bengal was transferred to the care of Augustinian monks from Goa. At the end of the sixteenth century there were churches at Jessore, Bákla, Dacca, Ṣrípúr, and Noricol,[1] supported by Portuguese settlers and native converts.[2]

Very little is said of the internal condition of the country. Ḍákáits infested the tidal branches of the Ganges at that time. as they did two centuries later. The country generally was remarkably fertile, and the abundance of corn and fruit almost incredible. Wherever they went the Hindu and Muhammadan inhabitants treated them with marked respect and kindness. Father Pimenta has left us the following charming description of the scenery of the Delta.

"The route from Baklá to Jessore [Ciandeca] is so agreeable and picturesque that I have not seen its equal. Plains irrigated by numerous rivers whose banks are adorned with the most beautiful trees. On the one side you perceive large herds of deer, on the other flocks of cattle. I forbear mentioning the luxuriant fields of rice, the thickets of sugar-bearing reeds (*Arundineta calamis mellifluis redundantia*), the hives of bees, the monkeys bounding from tree to tree, and such like objects that afford pleasure to travellers. Tigers and crocodiles that feed through our neglect, or fault, on human beings, are common. In the woods rhinoceroses are seen, but this far I have met with none."[3]

In 1602, the Portuguese of Chittagong, being harassed by attacks of the Arakanese, made Sondíp their chief stronghold. This island, situated in the estuary of the Ganges, is probably the oldest and most permanent of the group which the mighty river is for ever building up and destroying. It had belonged to the Rájah of Baklá, but the Muhammadans took possession, and when Le Blanc and Caesar Frederick landed, between 1565 and 1586, the Moorish inhabitants were most friendly and courteous. The fertility of the island was unparalleled, the population large and prosperous, and the cheapness of food extraordinary. The manufacture of salt and the trade of shipbuilding were carried on with great energy and success.

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[1] In Rajnagar, on the right bank of the Padma.

[2] For further particulars regarding the Jesuit Mission, see R.P. Petri Jarrici, "Thesaurus." iii, 2. c. xxix; "De rebus Japonicis, Indicis, etc." A Johanne Hayo, Scoto S.J.P., 809; "Exemplum Epistolae P. Nicolai Pimentae." Romae, 1602. [Also Josson, *passim.*]

[3] "Exemplum," p. 91. [Father Pimenta is quoting from a letter written in January, 1600, from Ciandeca by Father Melchior de Fonseca. The original Italian of this passage may be seen on pp. 31 and 32 of Beveridge's *Bakarganj.* H.E.S.]

The Portuguese, under command of Dominique Carvallho, a vassal of the Baklá Rájah, and Manuel de Mattos, from Chatigan, [p. 412] seized the island, but before they could secure their hold the King of Arakan[1] with a large fleet, and supported by a hundred "Kosahs"[2] from Srípúr, sailed for Sondíp. The Portuguese joined battle and were victorious, capturing over a hundred war boats, but so many of their own vessels were disabled that they hastily evacuated the island and retreated to Baklá, Srípúr, and "Ciandecan." The King of Arakan having recovered Sondíp invaded Baklá, threatened Jessore, and boasted that he would conquer the whole of Bengal.

In May, 1603, Carvallho was at Srípúr, a city belonging to the Bhúya Kedar Rái, superintending the equipment of thirty "Jaleas,"[3] when a fleet sent by the viceroy, Rájah Man Singh, and consisting of one hundred "Kosahs" under "Mandarai,"[4] hove in sight. Carvallho, hastily disposing his ships, engaged the enemy, and after a stubborn fight captured several vessels, and put the rest to flight. Mandarai was slain, and Carvallho severely wounded. The Muhammadan historian[5] gives a very different account of the battle. Kaid Rái Zamíndár of Bikrampúr, he says, had been subdued by Rájah Man Singh, but in 1603, forming an alliance with the Mag Rájah, he rebelled and laid seige to a fort near Sunnárgáon. On hearing of this rebellion the viceroy sent a force under Ibráhim Atka, and others. The confederates were defeated and many boats taken. The narrative, however, ends with the suspicious statement that the Rájah was compelled to entrench himself in front of the imperial troops to provide safety against their attacks.

Carvallho proceeded to Hughli to have his wounds treated and on his recovery, being invited by the Bhúya of Jessore to join in a war against the Mags, he proceeded, in spite of many warnings, to that court, where he was made prisoner and put to death.

Although the Portuguese were turbulent and lawless, pillaging Mags, Hindus, and Muhammadans without distinction, they were sometimes entrusted with high military commands in Bengal. For instance, Pyrard de Laval mentions[6] one "Jean Garie," who had under him ten thousand of the Bengal troops.

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[1] "Rex Tiparae, Chaconae et Bengalae, Pegusu dominus." De Jarric, tom. iii, lib. 3, c. xxix.

[2] A "Kosah" was a war boat driven by oars, but having one mast

[3] A "Jalea," from Sanskrit "Jala," water, was a name applied to boats generally.

[4] "Vir impiger et totâ Bengalâ notissimus." De Jarric. Mandarim was the title given by the Portuguese to any governor, or commander in the East. It is derived from "Mandár," to command. The English title, Mandarin, for a Chinese official, is the same word.

[5] Elliot's "History of India," vi, 109.

[6] "Voyage de François Pyrard de Laval," p. 239. ["Pyrard de Laval left India for Europe in 1610. He had been several years in the

In 1607 the Mag Rájah made war, captured Dianga, and [p. 413] drove the survivors to the islands of the Meghna Sondíp, which had fallen into the hands of the Mughals, was held by a force under Fath Khán, who had put to death all the Portuguese and the Christian slaves in the island. A few escaped with Sebastian Gonzales Tibao, and became pirates, plundering villages and conveying the booty to Baklá, where they sold it. Fath Khán having equipped a fleet, set sail to extirpate these pests, but Sebastian Pinto attacked his vessels off Dakhin Sháhbázpúr, destroyed a great number, and killed Fath Khán. In March 1609, the Portuguese, supported by troops from Baklá, laid siege to the fort of Sondíp, held by the Mughals under a brother of Fath Khán, while the Hindu population looked on with characteristic indifference. The fort was stormed and taken after a gallant defence The garrison and all the Muhammadans in the island, a thousand in number were in retaliation massacred in cold blood. Gonzales perfidiously broke the agreement made with the Baklá Rájah, and instead of paying him half the revenue obtained from the island refused to come to any understanding. The adjacent islands of Dakhin Sháhbázpúr and Patelá-bhanga were annexed and having in this lawless manner acquired possession of a small territory, Gonzales ruled both with wonderful tact and sagacity. Trade flourished, and the Portuguese became the envy and dread of the neighbouring princes. Good fortune also favoured them A brother of the Mag Rájah, expelled from his country, sought shelter at Sondíp. Gonzales married his sister, and after exacting a large sum of money is suspected to have poisoned his brother-in-law

The unsettled state of the eastern frontier and the devastation of the Delta by the Portuguese, forced Jahángír to transfer the seat of Government from Ráj-Mahal to Dacca. In 1608 the Viceroy, Islám Khán Fathpuri, removed to the new capital and at once took measures to extirpate the Portuguese, and secure a durable peace. The district of Dacca was then a settled portion of the Empire, but farther south Mughals, Afgháns, and rebellious vassals[1] contended for power. In 1610 the Mag Rájah made a treaty with Gonzales, in which it was agreed that the latter should command the allied fleets and act in concert with the Arakan army as it marched along the coast, and that all territory conquered should be equally

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Maldives where he was shipwrecked. An attack of the Mughs of Chittagong (?) on the Maldives gave him an occasion to escape in February or March 1607. He came for a month to Chittagong" H. H.)

[1] In a mosque at Faridpúr is an inscription of the date A.H. 1013 (1604), preserving the name of one 'Ajab Bahadur Khán Sultáni, but omitting all mention of an Emperor, which could only have been erected by a rebel

divided between the two contracting parties. The campaign began, Lakhípúr and Bhaluah were overrun, but on meeting the Mughal army the Arakanese, owing to the shameful defection of the Portuguese were totally defeated. Gonzales, a witness of the disastrous battle, [p 414] fled to Sondíp, after putting to death all the captains of the Mag fleet. The Mughals re-occupied Bhaluah without opposition, but did not follow the fugitives to Chátgaón. To consummate his villainy Gonzales waged war against his late allies, plundered and burned their villages, and, sailing up the Arakan river, attempted, but unsuccessfully, to capture the vessels anchored there.[1]

Up to this time Gonzales had refused to obey, or recognise, the viceroy at Goa, but in 1615, being hard pressed by the Mags, he submitted and urged an immediate invasion of Arakan. A fleet was accordingly sent under command of D. Francis de Menezes Roxo. It sailed up the Arakan river on the 3rd October, but the Mags, assisted by some Dutch vessels offered a stubborn resistance, and obliged the Portuguese to retire. In November, Gonzales arrived with fifty sail, when a combined attack was made, but De Menezes being killed, the assailants fell into disorder and retreated.

Gonzales returned to Sondíp, but his power and popularity were gone, and his dispirited followers quarrelling among themselves, allowed the Mags to take the island. After ruling nine years, Gonzales was stripped of his possessions; "his sovereignty passed like a shadow his pride was humbled, and his villainies punished."[2]

The Portuguese never recovered from this defeat, although their flag waved for many years unchallenged in the Delta, and the imperial Nawarah dared not meet their "Galliasses [1] in fair fight. Bernier,[2] however, makes mention of another Portuguese adventurer who acquired temporary power. "It was these same pirates," he says, "who at this time took Sondip, in which a certain notorious monk of S. Augustine, named Fra Joan, acted the petty sovereign for several years, having managed, God knows how, to get rid of (*se defaire*) the commandant of the place."

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[1] [For the origin of this account *vide* Faria y Sousa, Tom III, Pt II, Ch. IX, p. 179 of the Spanish edition. There is an English translation of his work in the Imperial Library, Calcutta H.H.]

[2] "Faria y Sousa," iii, 268. [After being forced to leave Sondip, Gonzales took refuge at Sripúr, and sent George de Sousa, accompanied by the Superior of the Sondíp Mission to obtain the permission of the Nawab of Dacca, to establish himself there. As the Nawab refused to allow the Superior to return to Sripur, this Father may probably be regarded as the original Catholic missionary in Dacca. Katrabo, on the Lakhya River, is also mentioned about the same time (1616) as a Christian settlement

On the news of the capture of Hughli in 1632 reaching Dacca the local Maulvies beat Father Bernard of Jesus so severely that he died a few days later. Another Bengali Christian of Sripúr by name Garcia was taken prisoner to Agra where he died in 1634. (Josson, *op .cit.*, pp. 322, 323, 363 and 364).

I was also informed by the late Father Altenhofen that Zaleski in *Les Martyrs de l' Inde* (Lille 1900. p. 340) records yet another instance of the murder of a priest at Dacca. He was beaten by Maulvies so severely that after two days, he died of his wounds. "P. Manuel das Chagos, Augustinian parish priest at Dacca, dies a martyr in this town, when visiting some Christian prisoners of the infidels in order to hinder their apostacy on Dec. 5th 1650" H E.S.]

For the next fifty years the Portuguese lived by piracy, and by making raids upon the peaceful villages of Bengal. Some entered the military employ of the Arakan monarch, and commanded expeditions sent against Bengal, Pegu, and Siam ;[3] others joined the imperial artillery, and Jahángír was wont to say that one Portuguese soldier would beat three of his own people. [p. 415] Many assisted Shah Shuja in his ill-starred rebellion of 1660, and when his cause was lost became Dákáíts infesting the Sunderbuns, and lying in ambush in a creek nea Sagar, still known as "Rogues' River," waylaid vessels beating up the Hughli.[4]

In 1662, the shipwrecked crew of the "Ter Schelling"[5] arrived at Bhaluah, where they found Muhammadans speaking Portuguese, and the Moorish commander protected by a body-guard "consisting wholly of Christians negro-born, and subjects of the King of Portugal," who were treated with especial honour on account of their valour. Other writers, however, give a different estimate of these "negro-born" Portuguese, and in the seventeenth century their usual sobriquet was "Gallinhas del Mar" [Sea Hens] on account of their habitual cowardice. The history of two centuries confirms the latter judgment, and, except under very exceptional circumstances, the Portuguese Eurasian has never proved himself a valiant soldier.

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[1] Tavernier describes the "Galeaça" as a long swift boat, often with fifty oars a side, and two men to each oar. It was generally gaudily painted and ornamented with blue colours and gold foil.

[2] "Historie de la dernière révolution des États du Grand Mogol." Paris, 1670. The incident is not mentioned by Faria y Sousa, whose history ends with 1640; and as Bernier left India in 1668, it must have occurred between these dates. [if it ever occurred at all. H.H]

[3] "Voyage de Wouter Schouten," ii, 168. [Josson records (*op. cit.,* pp. 364 and 365) that Father Manrique and other Augustine priests between 1622 and 1635 baptised at the Chittagonian ports of Dianga and Angaracole nearly 28,500 out of 42,000 prisoners taken by the Mughs and Feringis in Lower Bengal and Orissa, besides 6,000 others. H.E.S.]

[4] [This Portuguese fort at Saugor was first established after the fall of Hughli in 1632 (Josson, *op. cit.*, p. 363)]

[5]. A Relation of an unfortunate Voyage to the Kingdom of Bengala. By Mr. Glanius, London, 1682, 8vo. This is merely an English translation of "Vervarelyke Schip-Breuk van t'oost Indisch Jacht Ter Schelling under het landt van Bengale." Amsterdam, 1675, 4to. The author is Frans van der Heiden.

The capture of Hughli in 1632, and the slaughter of its brave defenders, was the death blow to Portuguese prestige in Bengal and in 1666, when Sháyista Khán determined on annexing Chátgáon and the islands at the mouth of the Meghna, he threatened the Portuguese with the fate of the Hughli garrison if they did not submit and become subjects of Sháh Jahán. The evil deeds which provoked the Muhammadan viceroy to interference are detailed by Bernier, a most prejudiced authority. Bad as the Portuguese undoubtedly were, their cruelty was exceeded by that of the Mags, who penetrated into the interior pillaging and ravaging the country, and leaving behind a name hateful even to modern Bengalis.

On the appointment of Sháyista Khán in 1664 to the government of Bengal, an expedition was organised against the Portuguese banditti. The fleet, a very powerful one, supported by several Dutch vessels, being put into the highest state of efficiency, was directed to act in concert with the army preparing to march on Chittagong. Alarmed by these preparations, and won over by bribes, many Portuguese left Chittagong "in forty or fifty galliasses," and gave themselves up as prisoners to the Nawáb at Dacca, who overwhelmed them with favours. Many were induced by large pay to enlist in the Imperial army, while a settlement at Farangí Bazár was established for the old and physically unfit.

p. 416] When the army and fleet of the Mughals advanced upon Chittagong, the island of Sondíp was occupied by Diláwar, a Muhammadan, and troops in league with the Mags. A detachment was landed the fort was beseiged and taken, but a Mag flotilla coming in sight, the troops were hurriedly withdrawn, and the transports sailed to Nawakhálí. In the following December [Nov. 1665] a larger force occupied the island, and held it. The main army then advanced along the coast, meeting with little opposition. Letters were sent to the Portuguese in the Mag service offering advantageous terms on submission. Several of these letters being intercepted the Mag Rájah tried to induce the soldiers to remove into the interior of Arakan, but refusing to do so, they finally left in a body for Bengal. On the 18th December, 1665, they arrived at Nawakhálí, and the leaders set out for Dacca, where they were graciously received by the Viceroy. Some were enrolled as volunteers under an Englishman named Captain Moore,[1] and joined in the expedition against Chittagong.

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[1] Nothing further has been learned regarding this soldier, but at the present day a small "Tappá" or division, in Bikrampúr is named after him. [As Father Hosten points out, Dr Wise has strangely misinterpreted the Portuguese phrase Captaõ Môr. It merely refers, as can be seen from Shiltābuddīn Tālish's account of the conquest of Chittagong (J. N. Sarkar, *J.A.S.B.*, 1907, pp. 405-425) to the Chief Captain (Mor = Major) of the Portuguese, and not to an Englishman at all].

On the 26th January, 1666, the garrison of that town capitulated and the Portuguese soldiers who had distinguished themselves in the campaign received grants of land.[1]

With the capture of Chittagong and the pacification of the Eastern frontier the history of the Portuguese, as an independent and aggressive power, terminates. Throughout the Dacca and adjoining districts numerous settlements of Portuguese Christians are still to be found, but none can claim relationship with the soldiers of the seventeenth century.[2]

The following sketch of the Portuguese mission since its foundation in Bengal embraces the origin and history of these settlements.

The Portuguese mission in Bengal was founded in 1599, by the Augustine, Archbishop of Goa. On arrival at Hughli the missionaries obtained a grant of rent free land. This grant originally consisted of 260 acres, but during last century it dwindled one-half. A chapel was built at Bandel, near Chinsurah and dedicated to "Nuestra Senora del Rosario." The first "regent" was Fre Bernardo de Jesus, and to this church all the other parochial churches in Bengal were affiliated.

Since the beginning of the seventeenth century the Bishop of S. Thomé, or Mailapúr, in Madras, has been the head of the Bengal Church. In 1606, Pope Paulus V made S. Thomé an episcopal see and by consistorial letters annexed to it the provinces of Bengal, Pegu, and Orissa. The special mission to [p. 417] Bengal was vested in the Augustinian monks of Goa, upon one of whom the title and prerogatives of Vicar General were conferred.

A tradition is preserved by the mission, that in 1599, one of their number, Fre Luis des Chagos, was stopped on his way to Silhet by certain Christians who besought him to relieve them from landlord tyranny. On his return he bought the villages and lands of Nágori and Bhágori in Bhowál, settling in them thirteen families of Christians, including a converted Bráhmin.[3] A piece of land was also purchased at Náráyandih, a suburb of Dacca, which still belongs to the mission.

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[1] [For a fuller account of the conquest of Chittagong *cf.* Shihābuddin Tālish's continuation of the *Fathiyyah-i-ibriyyah* (abstract by J. N. Sarkar in *J.A.S.B.*, 1906, pp. 257–260, and translation in *J.A.S.B.*, 1907, referred, to in previous note). H.E.S.]

[2] [If Dr. Wise had inserted the words 'so-called' before "Portuguese Christians," this sentence would have been much nearer the truth. But apparently, from what he says later the possibility that the possession of a Portuguese name did not necessarily involve the owner's descent from a Portuguese, did not occur to him. H.E.S.]

[3] [As Father Hosten points out, the date of 1599 is impossible. The real name of Fre Luis das Chagos (of the 5 wounds) was Luis dos Angos, and he died in Sylhet in 1696 (*O Chronista de Tissuary*, Nova Goa, 1867, Vol. II, p. 58) quoting from a report of the Father Provincial of the Augustines dated 1750. Fre Luis had bought land at Nágori to settle

The church of Nágori, however, bears the date 1664, and is dedicated to St. Nicola da Tolentino,[1] the patron saint of the Augustine order.

During the seventeenth century the success of the Augustine monks was most extraordinary. In 1602, three years after its foundation, the Hughli mission consisted of over 500 persons, among whom were many "grands seigneurs," and by the end of the century the sacrament was administered to 10,000 converts.

The parochial church of Dacca, dedicated "a la Assumpcion de nuestra Senora" was at Tezgaon on the north of the city, and its graveyard still contains the oldest tombstones and epitaphs in Eastern Bengal.[2] The early history of the mission is very interesting. Its success was chiefly owing to the conversion of a member of a distinguished Hindu family. The son of the Zamíndár of Bosnah,[3] one of the twelve

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there the remnants of the Christians of Don Antonio de Rozario, the converted son of the Rajá of Busna (*vide infra*). This settlement, according to the same authority, took place in 1695, though the date given by Dr. Wise in his next paragraph for the foundation of the Nágori Church, viz. 1664, agrees with that quoted by Father Hosten from the *Annuario da Archid. de Goa* for 1897 (pp. 193--194): *vide* his notes on Archdeacon Firminger's translation of Père Barbier's letter of 1723 (*Bengal: Past and Present*, 1910, p. 223). 'Bhagori' may be the village of Pangora near to Nágori; and the mention of a converted Brahmin is presumbly a reference to Don Antonio who belonged to this caste. H E.S.]

[1] S. Nicola da Tolentino died A.D. 1308, and was canonized by encyclical letters of Pope Eugenius IV, in 1446. [The Nagori Church was apparently the 'principal church' of the Christians visited by Bishop Laynez in the spring of 1714, on his return towards Dacca from Rangamatí (Assam) and Husainpur (Mymensingh) *cf.* Josson *op cit.*, 1914, pp. 5 7. H.E S.]

[2] [According to the *Annuario da Archid. de Goa* for 1897 (quoted by Father Hosten on p. 23 of his notes on Père Barbier's letter already referred to) the church of Tezgaon dates from 1714. The earliest monumental inscription noticed by me in the church during a visit in 1913, was dated 1725. As noted by the late Father Altenhofen, Dr Wise here confuses two churches. The original parochial church in Dacca was dedicated to Our Lady's Assumption; that at Tezgaon to Our Lady of the Rosary. The present Portuguese church in Dacca (which was only built in 1815) bears the name of Our Lady of Piety. H.E.S.]

[3] Donde assiste Don Antonio del Rosario, hijo del Rey de Busna, a quien no sole convertieron nostros religiosos sinoque le redimio del cautiverio el Padre Manuel del Rosario, p. 24. "Christiandad del Japan" Su Autr. El P.M. Fr. Joseph Sicardo. En Madrid 1698 fol.

[For full details of this convert of Busna (N.W. Faridpur) *cf.* Josson, *op cit.*, pp. 375-381 and Hosten in the *Catholic Herald of India*-weekly numbers from Sept. 19th to Dec. 26,1917. Antonio--his Hindu name is not recorded—had been captured by the Maghs in 1663 and was ransomed by Father Manuel del Rosario of Chittagong. Being a Brahmin he was at first most unwilling to become a Christian, but St Antony appeared to him in a dream, and this 'sign from heaven,' led him to be baptised On returning to Eastern Bengal about 1670 he induced within a short time over 30,000 persons to embrace the Christian faith; but the allegiance to Christianity of the Kumar's people at all events seems to have

Bhúyas, moved by the preaching of the monks. was persuaded to become a Christian. Being baptized as Don Antonio del Rosario, he induced his wife and brethren to follow his example.

Manrique,[1] a Spanish Augustine monk, describing Dacca in 1641, mentions that families of Christians resided in the suburbs, at Náráyandih "Manaxor," and "Pulgari," and that a handsome though small, convent, as well as a good church, existed. Much intolerance was practised by Muhammadan Mullas. Pírs, and Darweshes, who denounced all Christians for eating animals slaughtered in an unorthodox way. The Nawáb, however, protected them and the position of the mission was so secure that another chapel and residency were about to be built in Dacca as well as two in the Bandels of Srípúr and Noricol.[2] In [p. 418] 1679 the converts in Eastern Bengal

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been largely nominal and Don Antonio had constantly to be rescued from the debtors' prison at Dacca where he was consigned for debts, said to have been contracted in converting his ryots to Christianity About 1685 the Provincial of Goa "ne tarda pas à retirer ses missionaires de ce champ infécond," and finally, in 1695, the scanty remnants of the 30,000 with some others whom the Father himself had converted to the faith, were removed by Father Luis dos Angos to Núgori which had been bought by this Father to prevent his Christians from being molested by non-Christian landlords. Don Antonio is said to have gone there too, and died in the end a good Christian.

From a list of places given in Father Antonio da Magalháis' letter of 1678, especially the portion reprinted by Father Hosten in the *Catholic Herald* for October 17th, 1917, it appears that Don Antonio's work of conversion was chiefly carried on, not in Faridpur or Jessore, as one might have expected, but in the north of the Dacca and south of the Mymensingh districts along the Lakhya and Brahmaputra (*cf.* the villages Sagordi, Simulia, Egarasindhu and Dugduga). From a mention of Sirot and Baldacal, he may also have worked in Sylhet. H.E.S.]

[1] "Itinerario de las Missiones que hizo El Padre F. Sebastian Manrique." Roma, 1649, 4to. [Previous to his visit to Bengal in 1841, Manrique had come to Hughli in 1628 and from there had gone to Arrakan where he remained from 1629 to 1636. He died in 1669 (*vide* Father Hosten's edition of the translation of the first 20 of the 89 chapters of Manrique's work in *Bengal: Past and Present* for 1915-1918.) H.E.S.]

[2] [In order to amplify Dr. Wise's excerpt from Manrique's Chap. V —besides correcting slight topographical inaccuracies—I quote the relevant passages from Father Cardon's translation (*Bengal: Past and Present*. 1916, and Vol. XIII, pp. 2 and 3). "The City of Daack, or Daca, as they say in Portuguese, is the largest of all the cities of Bengala. . . . It is situated in a beautiful and very extensive plain on the bank of the famous and, at this place, fertilising Ganges. It extends for over a league and a half along its banks, and has as its ornaments at both ends the famous suburbs of Manaxor, on one side, and of Narandin and Pulgari on the other. Those suburbs are inhabited by Christians, and it is there my holy Order possesses a pretty, though small, Convent with a good Church. ... I was told that the inhabitants of this Gangetic emporium and its neighbourhood amounted to more than two hundred thousand, without counting the strangers. They come hither in the interests of their trade, to avail themselves of the great opportunities the city affords them; others the sons of Mars, come to enjoy on these

were estimated at 30,000, and Don Antonio, attached to the Church of Norícol in Rájnagar, had joint charge with the "rector" of 1,000 Christians.

At the end of the seventeenth century the Portuguese churches in Eastern Bengal and Assam were those of "Chandpur" in Tipperah, Banja,[1] Pippli, Balasor, "Tambolin"-[Tamluk, Midnapore], Jessore with 300 Christians, Hughli, Tezgáon, Dacca, and "Arrayal de Bencamatis," or Rangamati in Assam. In 1713 Laynez, Bishop of S. Thomé, visited Bengal. He found Christian congregations at Hughli, Pippli, Chittagong Dacca, Husainpúr in Mymensingh, [Nágori[2]] and Rangamati, in Assam.

It is difficult to arrive at any certain conclusion regarding the number of Portuguese Christians at different periods. Bernier was told by the priests that Hughli contained over 8,000, and that in other parts of Bengal there were 25,000 Monsignor Cerri,[3] secretary of the congregation De propaganda fide, writing about 1680, estimated the number at 22,000 divided into eleven parishes, each of which had a vicar and a curate. It was, he admits, hard to find any adult converts save Portuguese slaves, who had been bought and made Christians. In 1840, according to Mr. Taylor,[4] the number belonging to the

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frontiers (*fronteras*) the large mainàs, or pay and salary, which are given there. Not less marvellous is the abundant supply of implements and eatables. Anything man's desire can wish for is to be found there, especially in the numerous Bazars or markets (*Plazas*). I would wonder there at the sight of the quantity and variety of fowls and wild birds, all of them sold alive, and so cheap that it was like giving them away for nothing. For less than a silver real (four annas), in fact, one could very often get twenty turtle doves or fifteen big wild pigeons, and all the other things went for the same price, more or less, . . . The wealth of this city is greatly due to the fact that it has in its neighbourhood the fertile and delightful kingdoms of Bacala (North Bakarganj), Solimanvàs (South Bakarganj) and Catrabò (North of the present Dacca District). In this city (Katrabo) the first Religious built another Church and Residence, and a little after two others in the Bandels of Siripur and Noricul." Manaxor is Manaswar, a large village at the western extremity of Dacca city, and Narandin is Náráyandia, at the eastern end of Dacca. Both are ancient settlements, post Gupta coins having been discovered at the former, while at Narayandia there is still a mosque with inscription dated 861 A H. (1457 A.D.: *vide J.A.S.B.*, 1910, pp. 141-145). Pulgari, as Father Niard has already suggested to Father Hosten, may be Phulbaria, a mile to the N.W. of Narayandia, near the present railway station. Some Feringi Christians still reside there. H.E.S.]

[1] [Dr. Wise adds in the text "perhaps Banga in Farṛidpúr"; but Father Hosten in his note 5 to Chap. V of the translation of Manrique's *Itinerario Oriental* (*Bengal: Past and Present*, 1916, Vol XIII, pp. 19 and 20.) shows that it was (like Pippli and Balasore) not far from Tamluk—probably on the Haldi River.]

[2] [*Cf.* Note 4, p. 35.]

[3] "An account of the Roman Catholic Religion throughout the world" translated by Sir Richard Steele. London 1715.

[4] "Topography of Dacca", p. 252.

three parishes of Dacca, Bhowál and Husainábád was 10,150. In 1873, the Portuguese vicar of Husainábád calculated that 3.000 persons belonged to his church. while the French priest of the adjoining parish [Bandura Golla] rated his at 1,200.

The census of the Dacca Farangís for 1877 and 1878 has been kindly furnished by Mr. R. D. Lyall, C.S., who considers the returns of the French Mission more exact than the Portuguese :—

Mission.	*Parishes.*	1877.	1878.
Portuguese ..	Dacca ..	103	212
	Nagori ..	1,221	1,265
	Tezgáon ..	140	122
	Husainábád ..	2,820	2.823
		4,284	
French . ..	Bandura ..	5,000	1.440
	Tumiliá ..		2,020
	Sualpur ..		[600?]
			[4060]

The total number of Dacca Farangís may therefore be estimated at 8.500, but nearly 2.000 under the French fathers, being converted natives, have no right to be called Farangís at all.

[p. 419] The system by which the Portuguese made converts was not one that could prosper. Children of both sexes. either kidnapped or purchased, were made Christians, while girls after baptism became concubines and their offspring Christians. At one time this trade flourished to such an extent that the slave dealers boasted of having converted more Hindus in a year than all the missionaries of India did in ten. When the Portuguese power in the Delta was overthrown slave-catching ceased, and a final blow was dealt to this novel plan of converting the natives. With the seventeenth century the Portuguese mission ceased to triumph, and during the last century and a half it has not held its own against Muhammadan aggression. Many reasons for this failure are assigned, but Monsignor Cerri refers it to the immorality of the priests and laity, the former leading loose lives, exhibiting great ignorance and extreme avarice. and retaining large staffs of servants given up to all manner of vice and lewdness. The Goa priests. to whose care the Christians of Bengal were confided, have for many generations been half-castes, born and bred at Goa. Each parish church, moreover, is endowed with rent-free land, or with property held and managed by the vicar. Communication with S. Thomé being irregular and uncertain, the internal economy and discipline of the parishes are not interfered with as long as the annual donation is sent to Goa An illiterate priesthood, a rich isolated establishment, and a simple credulous laity, was a combination of evils sufficient to ruin any church. No one who has given a thought to the

Portuguese clergy of Eastern Bengal can wonder that they, inheriting a faulty system from their predecessors, have failed to instil new life among their flocks. Occupied as they generally are with the management of valuable church property, and of law suits inseparable from the possession of land in Bengal, little time, and less zeal, are expended on the spiritual welfare of their tenantry. A school is always attached to the church, but the instruction given is of the most rudimentary kind, and no attempts are made to raise the standard of education.

Such being the actual state of matters, it is not surprising that the congregation De propagandâ fide has for long been striving to gain possession of the churches and endowments of the Portuguese mission. Various law suits have been instituted, and in several instances, as at Dacca and Chittagong, the decision of the courts has been in favour of the congregation [1] The French mission, guided by the able and benevolent Monseigneur Dufal has within the last fifteen years [i.e. prior to 1875] infused new spiritual life among these neglected Christians. The good bishop, assisted by an admirable staff of clergy, devote themselves to improving the people, and their schools are crowded with hundreds of [p. 420] boys eager for knowledge. The nuns of the "Sacré Coeur" are engaged in an equally beneficient task. To them is confided the religious and moral training of the girls, and the schools conducted by them are models of order and propriety.

Two centuries ago the Portuguese Christians were divided into three classes "reynol," including those born in Europe, "castiço," those born in India of Portuguese parents, and "mestiço," or half-castes. These three classes no longer exist. The modern Christians are for the most part the offspring of the last and most numerous division, but they have lost all traces of their European parentage. Here and there a face characterised by large and rugged features strikes a stranger accustomed to the regular and more delicate lineaments of the average Bengali, but in complexion the Farangís are as swarthy as a Chaṇḍál The distinctive and favourite appellation of these Christians is Farangí, but the natives nickname them the "Kálá Maṭṭi," earth coloured Farangís.

The Farangí peasant dresses exactly like the Hindu or Muhammadan ryot, but on gala days, especially among the wealthier classes, the peculiar costume, still worn at Chittagong, is put on. It consists of striped drawers, a shirt, or cloth doublet, a skull cap with flaps fastened behind, and slippers. The women on festivals wear a white lace veil, or mantilla, covering the head and shoulders, while the common dress is a petticoat and a loose muslin jacket.[1]

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[1] [The only case known to me in Eastern Bengal was that regarding the right to appoint to the living of Padri Sibpur, Bakarganj, which was ultimately lost by the Propaganda (*vide* Beveridge's *Bakarganj*, pp. 107 and 108). The dispute was finally settled by a Concordat between Leo XIII and the King of Portugal in 1886, whereby the Portuguese Mission only retained jurisdiction over the churches and property they then possessed. If any members of their flock chose to go elsewhere, they passed under the jurisdiction of the Bishop of Dacca. H.E.S.]

In Bhowál the title Bocto (Sanskrit Bhakta, a worshipper), is exclusively applied to the families of the first settlers, but in other places the name, it is said, was given to the secretaries who also acted as catechists in the absence of the pastor.[2]

According to the French clergy, the Dacca Farangis are more moral, but quite as improvident as those of Chittagong. A poor man will not hesitate to borrow three hundred rupees for his marriage, while the rich will often squander eight hundred for the same purpose. The Bazár rate of interest being exorbitant, the borrower becomes impoverished for life, and rarely succeeds in clearing himself of the debt. The large majority of Farangís in Eastern Bengal are simple peasants, but many young men go to Calcutta, taking service as cooks, or undertakers ("Poberies" from the Portuguese Pobre, poor).

The peasantry are industrious though poor They cultivate the church lands, but the profit of their toil goes to Goa to support churches and monasteries. On the whole their position is an [p. 421] unenviable one, being worse than that of ryots under good native landlords, who generally do something for the improvement of their estates.[3]

The minor excommunication, depriving the sinner of the sacraments until he yields and confesses his faults, is at once a powerful and convenient weapon for subduing any quarrelsome ryot. When the priest is only the farmer and a Bráhman the landlord, the edifying spectacle is seen of a peasant appealing to the latter for redress, who if he thinks the punishment excessive, issues an order to readmit the accused to all the privileges of the church, and very rarely is the order disobeyed.

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[1] For further particulars regarding the "Feringhees," see "Calcutta Review." Vol. liii, for 1871. [For the clothes worn at weddings *vide* Pl. I, (3), and Pl. II H. E. S.]

[2] Père Barbier, however writing from Chittagong in 1713, says "Les Chrétiens du dedans des terres, nommés Boctos." Lettres Edifiantes ii, 590. [These still exist near Sultanpur, 15 miles N.E. of Chittagong, but they have lapsed to a sort of Hinduism. They claim to be Kshatriyas, but communication with them is regarded as polluting by orthodox Hindus. Most of them serve as musicians and singers at festivals, though of late some have taken to business (Letter from Father Altenhofen quoted by Father Hosten in *Bengal: Past and Present*, 1910, p. 221.)]

[3] [This paragraph certainly gives a wrong impression—at all events of things as they now are. The Mission under the Bishop of Dacca has no church lands; and any surplus on the working of the Zemíndárí of the Portuguese priests is sent, not to Goa, but to Meliapur for the assistance of other missionary enterprises. I am extremely doubtful also of the accuracy of the next paragraph, save possibly in a few isolated cases in the past. H.E.S.]

The majority of Farangís read and some write Bengali, which has become the vernacular of all classes. Each individual is given at Baptism a Portuguese name, but an assumed Bengali one is commonly used. A few Portuguese words are still spoken, and the names of festivals and religious ceremonies are the same as in Europe. Yet, strange to say, Lent is called "Roza," the Persian name of the Ramazán fast. No Farangi possesses a Bible[1] but each one wears a rosary and a crucifix. On Fridays they eschew flesh and during Lent observe a strict fast. In most houses a recess, containing an altar, or "Prie-dieu," is found, before which a lamp is lighted every evening, and on which flowers are arranged on "festá" days.

On account of the prejudices of Hindus and Muhammadans there is no Farangí shopkeeper in the villages of the interior. In Bhowál, swine are generally kept and large quantities of ham, bacon, and pork sausages, exported to Calcutta[2]

Farangís live in friendship and neighbourly sympathy with the natives, and are generally esteemed for moderation and liberality. They cannot, however, be considered the equal of the frugal, sober, and industrious Hindu or Muhammadan ryot In blind subservience to their priests, in superstition, and in servility to oppression, the Farangís are on a par with their neighbours, but in their intemperate habits, against which the pulpit fulminates in vain, they sink below the non-Christian races around them.[3]

APPENDIX III.

"Historical Prècis of the Connection of the Congregation de Propagandâ Fide with Eastern Bengal."

(Together with recent figures relating to the number of Indian Catholics in the Dacca District)

Through the courtesy of the Rev. Father A. E. Blin. C.S.C., Vicar of the Cathedral, Dacca, I am enabled to add the following notes on the Propaganda Mission to Eastern Bengal during the last 85 years, collected from two volumes of typewritten, transcripts from the *Catholic Herald* and *Indo-European Correspondence* (1845–1912) in the Library of the Bishop of Dacca.

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[1] ["There was no translation of the Bible for Catholics till lately when the Bishop of Krishnagar published the New Testament ; but in Dr Wise's time there were catechisms, prayer-books and many other things Dr. Wise did not know that the three first books ever published in Bengali, dating from 1743, were published by the Augustinians. The Jesuits who laboured among the Christians of Don Antonio had been active too at preparing vocabularies, a grammar, a catechism, etc. H.H 7-10-13"]

[2] [Swine are no longer kept, so this trade has ceased. H E.S.]

[3] [As in the case of most other Bengalis of the present day, blind subservience to any body is certainly a thing of the past and the common complaint of the priests is the refusal of their flock to listen to reasonable advice or admonition. In the case, however, of intemperance a distinct change for the better is said to be perceptible H.E S.]

From 1834, when the Rev. Dr. St. Leger was appointed by the Propaganda Vicar Apostolic of Bengal, till 1845, Easttern Bengal formed part of the Vicariate of Calcutta In the latter year steps were taken to erect this portion of the Province into a separate Vicariate, the first acting Vicar Apostolic being the Rt. Rev. Dr Thomas Olliffe.[1] During his time, in 1847, the first Sisters (of the Loreto Order) came to Dacca and established the Nazareth Convent in the house next to St. Thomas' Protestant Church. On the death of the Most Rev. Dr. Carew in November 1855, Dr. Olliffe assumed charge of the Western Bengal Mission and for the next five years Eastern Bengal was under the charge successively of the Very Rev. A. Goiran, Vicar General (till 1857) and the Rev. L. A. Verité of the Congregation of the Holy Cross (Pro-Vicar Apostolic) This Order of Priests, whose mother-house was at Le Mans, France, had first come to Eastern Bengal in 1853. On the death of Father Verité in 1859, Dr Peter Dufal of the same Congregation, who had come as a Missionary to Bengal in 1857 was appointed in July 1860 as the second Vicar Apostolic and continued to hold charge of Eastern Bengal for the next sixteen years, with the exception of a short interval in 1867–68 when he went back to France for about a year as Superior General of the Congregation of the Holy Cross

In 1876, on the resignation from ill-health of Bishop Dufal[2] the Mission passed for a time into the hands of the Benedictines, owing to the crippling of the resources of the Congregation of the Holy Cross by the Franco-Prussian war. The Rev Father Cuthbert Downey, O.S B., acted for two years as Pro-Vicar Apostolic, but in 1878 the Rt Rev. Dr. Ballsieper, O.S.B., was appointed as third Vicar Apostolic of Eastern Bengal. During his Vicariate, in 1882, Nuns of Notre Dame des Missions of Lyons first came to Chittagong ; and in 1888 the Mission in Dacca was again placed in the hands of Fathers of the Order of the Holy Cross.

The final settlement of the dispute between the Propaganda and Padroado (Portuguese Mission) was arrived at in 1886 when a fuller concordat than that of 1857 was drawn up and a Bull (" Humanae Salutis Auctor," 1 Sept., 1886) was issued to give force to the settlement. At the same time, the Indian Hierarchy was established, and the whole of the country divided into provinces, Dioceses, and Prefectures Apostolic.

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[1] Dr. Olliffe was confirmed as Vicar Apostolic by a decree of the Sacred Congregation de Propagandâ Fide, dated 15th February, 1850.

[2] Mgr. Dufal, who held the title of Bishop of Delcona, *i.p.i.*, died at Neuilly-sur-Seine in 1898, aged 76

Mgr. Ballsieper became the first Bishop of Dacca.[1] On his death in April 1890, the aged Mgr. Augustin Louage C.S.C. was made Bishop (in 1891), and when he, in turn, died in June 1894, he was succeeded by the Rt. Rev. Father F. J. Hurth. In 1898 Sister Catechists of the Order of Mary Immaculate, Paris, arrived in Dacca to take the place of the Sisters of the Holy Cross who had withdrawn the previous year. Bishop Hurth continued his work until 1909, when he resigned owing to ill-health, and the Rev. Father F. F. Linneborn, C.S.C., became the fourth Bishop of Dacca. Bishop Linneborn died in July 1915 and was succeeded by the present (fifth) Bishop, the Rev Dr Joseph Legrand, C.S.C.

Beyond one allusion to Nuns of the Sacred Heart of Jesus at Chittagong in the *Indo-European Correspondence* for Dec. 29th, 1886, I have been unable to verify the reference by Dr. Wise to Nuns of this Order carrying on work in Eastern Bengal. At the present time (1921) the nuns both in Dacca and Chittagong belong to the Order of Our Lady of the Missions. They succeeded the Sisters of Mary Immaculate in 1912.

As regards the present number of Indian Catholics in the Dacca District the subjoined table gives the latest figures recorded by the missionaries themselves. The Portuguese Mission figures are quoted from the Catholic Directory of 1914; while those under the Dacca Mission give the result of a Mission Census in 1911.

Name of Parish.	Number recorded.
Portuguese Mission	
1. Hashnábád	3,232
2 Tutail	912
3 Dacca	66
4 Tezgáon	225
5 Nágori	2,054
TOTAL (P.M.)	6,489
Dacca Mission.	
6. Bandura Golla	2,217
7. Solepur	945
8. Tumilia	3,973
9 Maulsaid	280
10 Bagunbari (now removed to Kamalapur and other villages near Sabhar)	150
TOTAL (D.M.)	7,565

The grand total is therefore 14,054, or an increase of about 5,500 (or nearly 65%) during the 35 years that elapsed between 1878, the date of the collection of the figures given in the last column of the table on p. 38, and 1913. The Dacca Mission is increasing at nearly twice the rate of the Portuguese Mission the proportions being 86% to 46%. This is due almost certainly to emigration from churches under the Portuguese to areas under the Bishop of Dacca. The total rate of increase is about 1·9% per annum as compared with 1.4%, the rate of increase recorded in the Census for Dacca District generally between 1881 and 1911.

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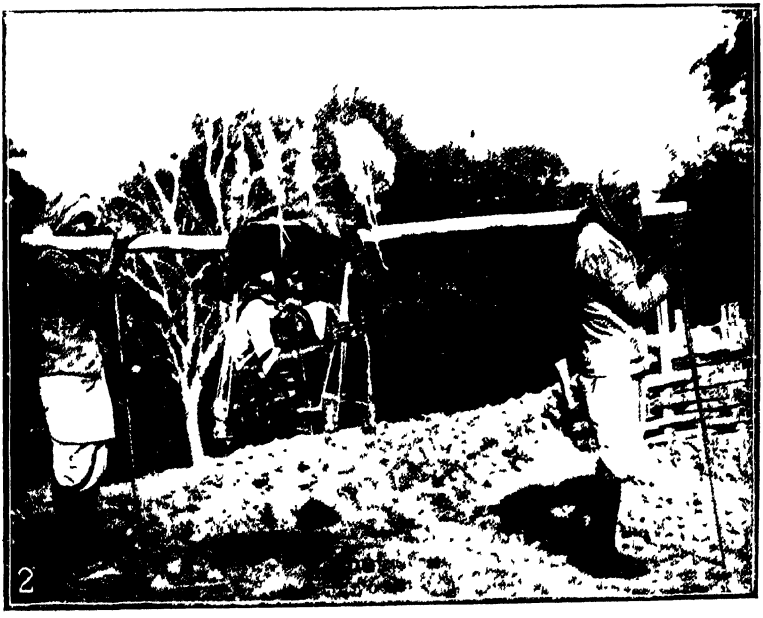
[1] The previous Vicars-Apostolic had only held titular Bishoprics *in partibus infidelium.*

It is only right to add that a considerable discrepancy exists between the figures stated above and the government census figures of 1911 and 1921. The 1911 census gave 11,468 as the total for the Indian Roman Catholics in Dacca District It may very possibly be the case that the Mission census included family members who were away on service in Calcutta and elsewhere when the government census was taken: while, on the other hand, some of these christians may have returned themselves on the government forms as Anglo-Indians. The preliminary figures at the recent 1921 census (for which I am indebted to Mr. J. H. Lindsay, C.S., District Magistrate, Dacca) showed a total of 12571—an increase over the 1911 total of 1103 persons, or 9.6%. The total population of the Dacca District increased during the same decade by 5.8%.

H. E S

ROMAN CATHOLIC CHRISTIANS OF DACCA DISTRICT



ROMAN CATHOLIC CHRISTIANS OF DACCA DISTRICT

6. Notes on Kharoṣṭhī Inscriptions

By N. G. Majumdar, M.A.

(Plates III–V).

1. *Shakardarra Inscription of the year* 40.

This inscription comes from a place called Shakardarra near Campbellpur on the North-Western Frontier, where it was discovered in an 'old well'.[1] It was first brought to notice in 1908 by Mr. R. D. Banerji who published it in *Indian Antiquary*, Vol. XXXVIII, p. 66 and plate. In 1916, Professor Sten Konow utilised the record in his learned paper on the Indo-Scythians,[2] where incidentally in a footnote he gave his own reading and translation of the inscription, which are, it is worthy of notice, materially different from those of Mr. Banerji. I now edit it from two excellent ink impressions kindly placed at my disposal by Professor Bhandarkar.

The inscription is now in the Lahore Museum. It is incised on a stone slab and measures 10″ × 7½″. The size of the letters is between 2″ and ½″. It consists of 4 lines and is slightly damaged at the right end.

The **characters** are Kharoṣṭhī of the Kuṣaṇa period as portrayed by Buhler in cols. X–XII of his Tafel I.—The **language** is a form of Prākṛit, but it does not contain, as Mr. Banerji wrongly thinks, 'a strong mixture of some foreign dialect.' So far I can see, it does not possess any foreign elements at all, being the same as the Gandharian Prākṛit, so familiar to us from other Kharoṣṭhī documents. The following characteristics may be noted: The *r* is retained in group in all words except *Pothavadasa* (l. 1) The nominative singular is rendered by *o* in *kovo* (l. 1), *khadao* (l. 1) and *daṇamukho* (l. 4). In *nikame* (l. 3), we have a hardening of *g* into *k*. There is only one case of assimilation, *viz.* of *ṣṭh* into *ṭh* in *Poṭhavadasa* (l. 1) —In respect of **Orthography**, the only interesting point to note is the substitution of the lingual *ṇ* for dental *n* in *daṇamukho* (l. 4).

I read the epigraph as follows :—

Text.

1 **Saṁ 20 20 Poṭhavadasa masasa ḍivas [e].**
2 **viśami di 20** [1*] Atra divasa-kale Śa. .
3 nikame kovo khadao Traṇivadreṇa saṁ. .
4 [gu ?]rave daṇamukho.[3]

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[1] This well must be the one mentioned in the inscription

[2] *S.B.A.W.*, 1916, p. 795, n. 1.

[3] After this there are engraved a deer and a fruit.

Remarks.

I have retained almost wholesale the reading of Professor Konow. The only differences however between his text and mine are the reading of *Tranivadrena* instead of *Tronivadena* in l. 3 and the recognition of the letter *ve*, which hitherto had escaped the attention of scholars, immediately after *ra* in l. 4 With regard to the former, *i.e. Tranivadrena*, I have to point out that at the bottom of the fourth letter *dra*. on the right-hand side, there is a short stroke which may be easily read as the subscript *r* on a comparison with the same in the conjunct group *tra* in l. 2. Regarding the first letter of l. 4, which I tentatively put as *gu* I have some doubts. Because it has a cumbrous shape unlike that of any Kharosthī letter so far known. I suggest however that, this might perhaps be due partly to the unsmooth surface of the stone and partly to the carelessness of the scribe, and that the original letter might be restored as *gu* so as to yield the reading *gurave* in company with the two letters that follow. I am aware that the fourthcase ending is generally substituted by the sixth case in Literary as well as Inscriptional Prākrit. But Sanskriticism even in case endings is not unknown. This somewhat rare use of the dative may not therefore be considered as altogether impossible [1]

Translation.

"**On the 20th day of the month of Prauṣṭhapada, of the year 40.** On this day, in the town of Sa.., has been sunk a well by Tranivadra.... (*which is*) a gift to (*his*) preceptor (?)"

Notes.

I have rendered *dānamukha* simply as 'gift' after M. Senart who was the first to show that it is only a synonym for *dāna*. This interpretation has been further strengthened by the luminous notes of Dr. Thomas in *J.R.A.S.*, 1915, pp. 97-99. But there are other scholars, who translate the word as 'an excellent gift'[2], no doubt on the assumption that *dānamukha* = Sk. *dānamukhya*. In addition to what Dr. Thomas has already shown I here invite attention to certain Jātaka passages which actually contain the word *dānamukha*. In all these places, as will be seen, it can have no other sense possible than 'gift.' In the Atthasaddajātaka[3] the Bodhisattva is said to have been born in a rich Brāhman family of Benares; he received his education at Taxila and after his parents had died spent all his fortune on gifts. In this connection we have 'sabbāni vibhavajātāni dānamukhe vissajetvā,' etc. Again in the Sasajātaka[1] the Bodhisattva is described to have made a gift of his own body. Here occurs the passage 'sakala-sariraṁ dānamukhe datvā,' etc. In both the cases, it will be admitted. the word means simply 'gift' and nothing more than that.

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[1] In an article contributed to the Sir Asutosh Silver Jubilee Volumes Prof. S. N. Majumdar proves the existence of the dative plural in 'epigraphic Pāli.' As the paper is not yet out I cannot refer to his points in detail.

[2] See e g. *A.S.R.*, 1902-3, p. 164; *Ep. Ind.*, Vol. XII, p. 299

[3] *Jātaka Text*, ed. Fausboll, Vol. III, p. 428.

The word *khadao* is equivalent to *khato* = Sk. *kṣata* which is used in the form *chata* in a Nāsik cave inscription [2] In the Āra and Zeda inscriptions[3] the form is *khade* in place of *khadao*.

2. *Loriyan Tangai Inscription of the year* 318.

This inscription which occurs on the pedestal of a Buddhist image comes from a place called Loriyan Tangai on the North-Western Frontier. It was first edited by M. Senart in *Journal Asiatique*, Serie 9, tome XIII (1899), p. 526, and then by Professor Vogel in the *Archaeological Survey Report* for 1903-4, p. 251 ff and plate. I now re-edit it from the original which is in the Indian Museum, Calcutta.

It consists only of 2 lines and measures about 1'.4" × 3½". The size of the letters is between 1½" and ½". The writing is in an excellent state of preservation.

The **characters** are Kharoṣṭhī of the Kuṣana period and the **language** is a form of Prākṛit.

I read the epigraph as follows :—

Text.

1 **Sa 3 100 10 4 4 Proṭhavadasa di 20 4 111** Budhaghosasa danamu[khe*]

2 Saghorumasa sadar Esarisa

Remarks

The letter *khe* is a restoration. No traces of it remain on the original stone, though Drs. Vogel and Bloch say that they are visible (cf *A.S.R.*, 1903-4, p. 251 and n 3).

Translation.

The year 318, the month of Prauṣṭhapada and 27th day. The gift of Buddhaghoṣa, (*and*) of Saghoruma[4] along with his wife Iśvarī

Notes.

The word *sadareśarisa* was left untranslated by Professor

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[1] *Ibid.*, p. 55.

[2] Cf. Senart's remarks, *Ep. Ind.*, Vol. VII, p. 10.

[3] See Konow, *ibid.*, Vol. XIV, p 143.

[4] Prof. Vogel compares the name Budhoruma of another Kharosthī record.

Vogel though he was right in taking the last member of the compound to be Īśvarī.[1]

The names of the two donors are not connected by *ca*, a feature already well known from other early inscriptions.[2]

3. *Wardak Vase Inscription of the year* 51.

This important record has been edited by Mr. Pargiter in *Ep. Ind.*, Vol. XI, p 201ff and plates, and re-edited by Professor Konow in *S.B A.W.*, 1916, p. 807 ff. The 3rd line of the epigraph, according to Professor Konow's reading, contains the following passage: *avi ya naragra paryata yava bhavagra yo adra—aṁtara—aṁḍajo jalayuga ya yetiga arupyata sarvina puyae bhavatu.* In this passage it is prayed that the merit acquired by the performance of certain religious acts might tend to universal veneration of all creatures. And in this connection mention is made of certain species of creatures that are to receive this veneration.—They are: *adra-aṁtara aṁḍajo jalayuga.* Now what is meant by *jalayuga* ? According to Mr. Pargiter it is equal to **jalāyuka* (*jala + āyu + ka*), 'meaning a creature which has its life in water.' Professor Konow on the other hand, proposes to take it as an equivalent of **jarāyuka* (*jarā + āyu + ka*)., i.e. according to him 'living beings.' I am, however, inclined to look upon *jalayuga* as made up of *jalāyu* (i.e. *jarāyu*) + *ka* being the Prākṛit correspondent of Sanskrit *jarāyuja* and Pāli *jalābujo*. The word means born from the womb,' i.e. viviparous, and is exactly suitable in the present case. The two other species of living beings are *adra-aṁtaraja* and *aṁḍaja*. The former is equal to *ārdr-āṁtaraja*. i.e. 'those who are born in the midst of moisture', and the latter of course clearly means 'egg-born.' Classifications of this nature, be it noted, are found in abundance throughout the Buddhist and Brāhmanic literature. Thus e.g. in the *Mahāvastu* (I, p. 211) and the *Abhidharmakośavyākhyā* of Yasomitra the Garuḍas and the Nāgas are classified according as they are *aṁḍaja*, *saṁsvedaja*, *jarāyuja* and so forth Again the same list occurs in the *Dharmasaṁgraha* edited by Max Müller (*Annec. Ox.*) and in Manu, I, 43–45.

4. *Taxila Copperplate of Patika.*

The standard edition of this highly interesting record is by the late Professor Bühler in *Ep. Ind.*. Vol. IV, p. 54ff and plate. Although the text has been on the whole correctly read and explained, yet in at least two places I would like to offer a different interpretation.

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[1] *A.S.R.* 1903-4, pp. 252.

[2] Cf. e.g. *Budhamitrasa Budharachidasa*, etc., in *A.S.R.*, 1903–4, p 254, and also Mathurā Lion-Capital inscription no. G, *Mahachatravasa Kusulaasa Padikasa Mevakisa Chatavasa puyae* ('For the honour of the Great Satrap Kusulaa Padika, (*and*) of the Satrap Mevaki ')—*Ep. Ind.* Vol. IX, p. 144.

In ll. 1-2 Buhler reads *Chahara [sa*] Cukhsasa ca Chatrapasa [1*] Liako Kusulako nama [1*] tasa putro Pa [ti] [ka*]*. Now the genitive in *Chatrapasa* is quite unexpected. The word refers to Liaka Kusulaka, whose name occurs immediately after it and is in the Nominative case I propose that there should be a *virāma* after *Chatrapa* and the *sa* be taken with the following clause *Liako Kusuloko nama*. I translate the entire passage as: "The Chatrapa of Chahara and Cukhsa- he by name Liaka Kusulaka (*sa Liako Kusulako nama*)—his son Patika"

Professor Lüders has suggested, and I think rightly, that the inscription belongs to the time when Patika was yet a *yuvarāja* (*J.R.A.S.*, 1909 pp. 664 5) The ruling overlord was his father Liaka. For an official endorsement of his son's record it was perhaps thought necessary that he also should express his approval in writing. On the reverse of the plate we accordingly find the names of both Liaka and Patika. This portion of the document has been read by Buhler as follows. *Patikasa chatrapa Liaka* He renders it as "of Patika, the satrap Liaka," which as it stands does not however convey any sense. Buhler supposes, though without any satisfactory grounds, that it means "Patika's (*father*), the satrap Liaka." But I do not think there is any proper justification for supplying the word 'father' in the translation In my opinion the difficulty in syntax is easily removed if we read the passage as: *Patika sa-chatrapa-Liaka* that is, "Patika along with the satrap Liaka." There may be just one objection to this reading being accepted, viz. that the name of the overlord (i.e. Liaka) comes after and not before that of Patika But this practice is rather common and traceable in other records also as e.g. the plates of Dantivarman of Gujarat the concluding lines of which are *mataṁ mama Śrī-Dantivarmmaṇaḥ Śrīmad-Akālavarṣadevasunoḥ tathā mataṁ mama Śrī-Dhruvarājadevasya Śrīmad-Akālavarṣadevasunoḥ*. Here the name of Dhruvaraja who is the paramount lord is mentioned after the name of his vassal Dantivarman

5 *Mehaban Inscription of the year* 102.

This inscription which is now in the Lahore Museum (No. 42) has already been edited by M. Senart in his 'Notes d' Épigraphie Indienne." *Jour. As.*, serie 9, tome 4 (1894), Part 2, p. 514ff and Pl. V, No. 35. I now re-edit it from two excellent ink impressions received from Rai Bahadur Dayaram Sahni through Mr. Ramaprasad Chanda, Superintendent, Archaeological Section, Indian Museum, Calcutta.

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[1] *Ep. Ind.*, Vol. VI, p. 294, ll 81-82.

It is incised on a slab of stone and measures 1'4½" × 7" The size of the letters is between 3" and 1'. The characters are Kharoṣṭhī of the Śaka variety. The *sa* in *putrasa* (l. 2) is archaic as in the inscriptions on the Mathurā Lion Capital; the *mu* in *daṇamukho* (l. 1) is not of the cursive type as found in Śaka and Kuṣana inscriptions; and further the letter *ka* has not that curvature in the head which is so characteristic of later epigraphs. The most interesting however is the conjunct letter *tś*[1] in *saṁvatśaraye* which was read *ts* by M Senart[2]. Its resemblance to the Central Asian *tś* is clear enough and here the two distinct letter-forms *t* and *ś* can be easily detected in the body of the ligature The ligature *ts* also does occur in North-Western Kharoṣṭhī documents. Thus in l 1 of the Pāja inscription of the year 111 the compound letter *ts* occurs, and not *tś* as supposed by Professor Konow[3]; and in this conjunct group the letter *sa* is very very prominent The language is a form of Prākrit.—The only interesting point to note is that the nominative singular is denoted by *o* in *daṇamukho* in l. 1 and *bhuo* in l 3. In *bhuo* we have an instance of the elision of *ta*. For similar elisions of the letter see Professor Luders' remarks, *J R A S.* 1909, p 664, n 2

Text.

1 daṇamukho [ı*]
2 Makaḍaka-putrasa Vayira[sa*]
3 [thuvo] saṁvatśaraye 1 100 1 1 bhuo.

Remarks.

For the reading of *ṇ* in *daṇamukho* see Professor Konow (*Ep Ind.*, Vol. XIV, p. 131) In l. 3, the first two letters were left unread by M. Senart. But I see clear traces of *thu* and *vo* here on the impression, though I am not certain that the restoration *thuvo* is beyond all doubt. Regarding the reading *tś* I have already discussed above. The last word *bhuo* i.e. *bhūtaḥ*, was read as *bhuho* by M. Senart, who restored it as *bhū* [*ti*] *ho* [*tu*]. For *o* cf. Thomas, *Ep. Ind.*, Vol IX, Table opposite p. 146

Translation.

"Gift The *stūpa* (*of*) Vayira, son of Makaḍaka has been finished in the year 102."

Notes.

Makaḍaka and Vayira sound like foreign names. For Vayira cf. *Vayula* in a Pathyar Kharoṣṭhī inscription—*Ep*

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[1] See N. G. Majumdar, "The Süe Vihār copper-plate", *Sir Asutosh Silver Jubilee Volumes*, Orientalia Sect., Part I, pp. 467-70.

[2] See Lüders, *Sitz. Kön. Preuss. AK. d. Wiss.*, 1912, p. 825.

[3] *Ep. Ind.*, Vol. XIV, p. 133, cf. Pl., *Ind. Ant.*, 1908, p. 65

Ind., Vol. VIII, p. 117. M Senart, however, thinks that Makadaka = Mārkandaka and Vayira = Vajra.

6. *Manikiala Inscription of the year* 18.

This well-known record has been thrice edited by Senart [1], Luders [2], and Pargiter [3]. Yet it cannot be said that its decipherment and interpretation have been placed beyond all doubt. To show how much still requires to be done I pick up a single passage (ll 9 11) which has been read in at least three different ways —

Senart—Etena kusalamulena budhehi ca spavaspahi ca saca sada bhavatu.

Luders—Etena kuśalamulena budhehi ca savaehi ca sacasana bhavatu.

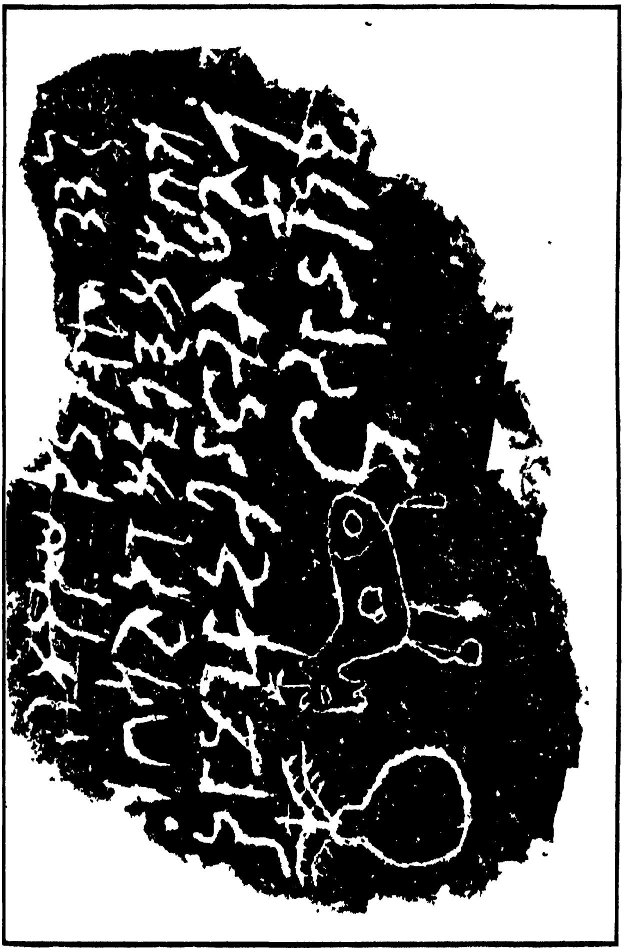
Pargiter—Sadhakadana-kusalamulena budhehi ca spantakahi ca sacasana bhavatu

But the plates accompanying M. Senart's paper show clearly in my opinion the following reading. *etena kusalamulena Budhehi ca athakahi ca samaṁ sada bharatu* I render it as: "And by this root of bliss and by the Eight Buddhas let there always be tranquility" As regards the reading *samaṁ* (i e *samah*) I have to point out that the upper portion of the second letter is a regular *ma* underneath which there is a short curve stroke, apart from the letter itself, that may be easily read as *anusvāra*. For a similar use of the word *sama* cf. the Sarnath image inscription of Budhagupt. which contains the following: *yad = atra puṇyaṁ pratimāṁ kārayitrā mam = āstu tat mātā-pittror = guruṇāṁ ca lokasya ca sam-ārtham* (*Arch Surv. Rep.*, 1914 15, p. 125).

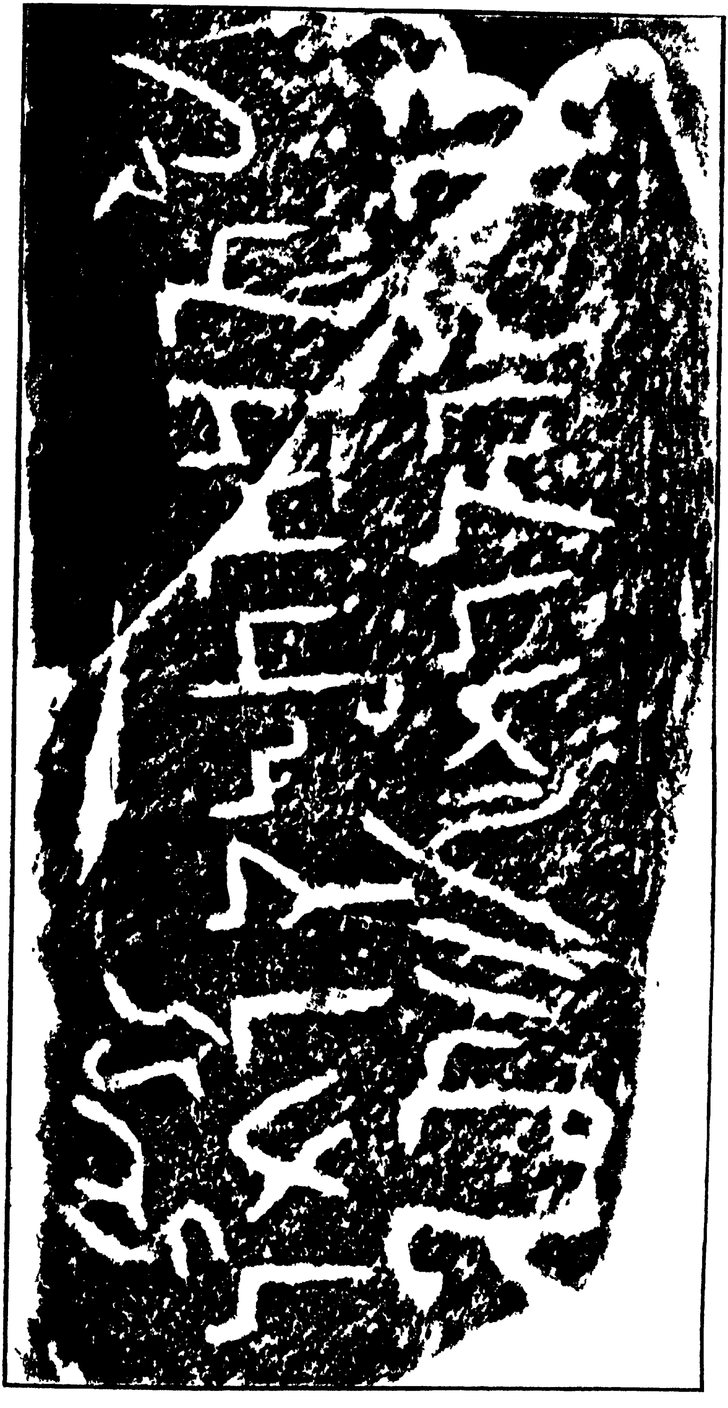
[1] *Jour* A S., 9 serie, tome 7, p 1 ff and plates

[2] *J R* A. S, 1909, p 666.

[3] *Ibid*, 1914, p 646



THE SHAKARDARRA INSCRIPTION



THE MAHABAN INSCRIPTION

7. Preliminary note on Isopoda of the family Bopyridae parasitic on Indian Decapoda Macrura.

By B. Chopra, M.Sc., *Research Assistant, Zoological Survey of India.*

(Read at the Ninth Annual Meeting of the Indian Science Congress and communicated by the Director, Zoological Survey of India.)

Nothing has so far been published about the Bopyrid Isopoda of the Indian Empire, and very little about those of neighbouring countries. A considerable amount of work has however, been done on the European forms by several workers in recent years, among others, by Giard and Bonnier, Sars, Bonnier and Tattersall, and the North American forms of both the Atlantic and the Pacific coasts have been more or less thoroughly investigated by Miss Richardson and some other scientists. Stebbing has described a number of species from Africa. So far as strictly Oriental forms are concerned, the islands forming the Malay Archipelago have received the most attention, though a number of species have been described from the seas around Japan. Giard and Bonnier based two of their new genera, *Probopyrus* and *Palaegyge*, on forms collected at Amboina and Weber recorded more species of these genera from Sumatra and the neighbouring islands. Later Bonnier described his genus *Orbione* from Hongkong; and *Bopyrella* from the Amis Island, Oceania. Nobili in 1905 added another species to the former genus from Singapore. Some of the forms described by Stebbing were captured in the Indian Ocean, near the coast of Africa, and a few so far east as the Maldive Islands. Horst has recently described another species of *Palaegyge* from Java.

Working through the collection preserved in the Indian Museum I find that the family Bopyridae is very richly represented in the fauna of this country. In all I have examined over thirty species belonging to thirteen different genera. As is to be expected in the case of specialized parasites like the Bopyrids, most of the forms in our fauna represent species hitherto undescribed. Of the thirteen genera two are new to science, while all the species except five or six have not been hitherto described. Two other forms parasitic on two species of *Latreutes* probably belong to a new genus to which an already described form from the coast of North America—*Bopyroides latreuticola* Gissler—must also be referred. I have not, however, set up a new genus to accommodate these forms as both of my specimens are in an unsatisfactory condition, being too damaged to be figured or described. Thus in our fauna Bopyrids parasitic on Macrura are represented by thirteen genera (or fourteen if that parasitic on *Latreutes* is to be considered new) and over thirty species.

Argeia Dana, which was hitherto known from a single species occurring chiefly along the Pacific coast of N. America, is represented by another species collected at Port Blair, Andaman Islands. The genotype of Bonnier's *Bopyrella*, with which genus I have also combined Hay's *Synsynella*, occurs in the Andamans, and besides this the genus is represented by a subspecies of Hay's *B. deformans* and another species which I have doubtfully referred to the genus. The genus *Bopyrina* Kossmann is already known from several species both from European and American waters. Five species have been met with in India, four of which are new. Four of these come from the Andamans, while the fifth is a coastal form found in backwaters at Cochin. *Bopyroides* Stimpson is so far known from a single valid species; to this genus I have referred provisionally another form parasitic on an Alpheid collected at the Andamans. Of the forms so far described under the genus *Bopyrus* Latreille, I have definitely recognised only a single species—*B. squillarum*. The Indian members of this genus parasitic on the common prawn, *Leander styliferus*, have been described as a variety of *B. squillarum*. A new species of Nobili's *Epipenaeon* has been found parasitic on a common Bengal estuarine prawn, probably *Penaeus semisulcatus*. The genus *Palaegyge* was hitherto known from eight species from the fresh waters of the Malay Archipelago and another doubtful one from the Canal zone in Central America. Of the eight Malayan forms two have been met with in India, one commonly in the Gangetic delta and the other in the deltaic waters of the Godaveri. Besides this, seven new species have been described, of which one is of special interest from the point of view of its host. All the sixteen species except this one, are parasites of *Palaemon*, while it lives on a *Leander*, a genus which was hitherto known to be parasitized almost exclusively by members of the genus *Bopyrus*. The genus *Probopyrus* is represented by two species, one collected in the Talé Sap in Peninsular Siam, the other occurring fairly commonly in the Gangetic delta. *Orbione* Bonnier has two species living in our waters; of these one, collected near the Andamans, has received a new name. *Hemiarthrus* Giard and Bonnier (= *Phryxus* Rathke) was hitherto known from two species, one found both in the European and American waters and the other exclusively along the Atlantic coast of N. America. Four new forms, all allied to the exclusively American species, have been collected in waters around the Andamans. *Diplophryxus* Richardson also lives in Indian waters. Of my two new genera one characterized like *Stegophryxus* Thomson and *Stegias* Richardson by the possession of triramous pleopods, is known from a single species parasitic on an Alpheid collected at Waltair and the Andamans. The other new genus allied to *Pleurocrypta* Hesse, is also known from a single species, which is based on a single specimen parasitic on a *Synalpheus* collected in Ross Channel, Port Blair. Andamans.

The distribution in Indian waters of the genera *Probopyrus* and *Palaegyge* presents a very interesting feature. All the species of these two genera occurring in Malaysia are said to be exclusively freshwater forms and are met with fairly far inland. One species of *Probopyrus* has been captured even at high altitudes. On the other hand the Indian species of these genera, though occurring for the most part in waters which are almost or even quite fresh, are nevertheless found in places within tidal influence, and some have actually been captured in places where the water is slightly brackish. Thus it is seen that the two genera which are exclusively fluviatile in the Malay Archipelago. are deltaic in the Indian waters. Dr. Annandale informs me that the same thing is observable in the case of several other genera and that, in fact, there seems to exist a more or less definite rule that certain forms which live exclusively in salt water in the west migrate more and more up stream as they proceed eastwards As an instance might be cited the case of *Leander*. This genus is exclusively marine in Europe; in India some of the forms ascend for a considerable distance up stream and one species. *L potamiscus* Kemp, is found in places where the water is quite fresh; in China the genus occurs in inland lakes along with species of *Palaemon*; while in Japan the common freshwater prawn is a species of *Leander*. The same is observable in the Molluscan genus *Modiola* It is marine in Europe; in India it is mostly marine but some species ascend up stream and become estuarine; while in China the genus is met with in the inland lake system.

Another interesting point in connection with distribution is the marked resemblance that the Bopyrid fauna of the Indo-pacific region shows to that of the Atlantic coast of North America. A number of genera are common to the two regions, and some of the species even show close affinity.

8. The Ḍhupī Copperplate Inscription of Rāmasimha. Śakābdā, 1720 (A.D. 1798).

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PRELIMINARY.

In March, 1921, I got information of a copperplate lying in the possession of the Mohānta of the temple (now in ruins) at Ḍhupī within the jurisdiction of the Jaintiapur Thana in the District of Sylhet and 23 miles from the Headquarters station I at once availed myself of a holiday to visit the place and see the owner of the plate and as a result I am able to edit and publish this inscription for the first time. On examination I found it to be the same as was briefly noticed by Sir E. A. Gait in his "Report on the Progress of Historical Research in Assam" (page 16) in the following words: "In this plate is set forth the grant by Raja Ram Simha of some land for the temple of Siva which had been erected by him at Dhupi"

The *plate* measures 8″ × 5¾″ and bears the royal seal on the upper right hand corner The seal is round in shape, having a circle of dots inscribed within two others. Inside the smallest circle is the device of a lion jumping over a bunch of water-lilies. The lion has its face turned towards the left hand side. The inscription is in twenty-eight lines, excluding the short invocatory line at the top and a few letters inscribed immediately above the first line. These letters were omitted by the inscriber from the main body of the inscription apparently through oversight One of the omissions is বিত্তা to be added after পরি in line 7, and the other ত্তা to be placed before the word শকাব্দা in line 28 Two parallel lines run along the four sides of the plate; and there is a small ornamental creeper design slightly below, or almost in a line with the last line, preceding the sentence bearing the date This creeper apparently indicates the place of ত্তা just as the "anunāsika" sign in line 7 indicates that of বিত্তা The lower part of the plate has sustained slight damage in two places, without, however, injuring any letter. Otherwise the plate is in good state of preservation and the inscriber has certainly the credit of a good hand.

The *characters* are modern Bengali with a few exceptions. The *ra* is written as in Assamese without the dot and with a line drawn across the upper part of the triangle. The conjuncts *Bhū* (e g. in line 2), *Śrī* in line 19, *ṇḍa* (line 9). *Ṣṭa* (line 9) *nna* (lines 7, 8, 22) and *rna* line 28 are slightly unusual and peculiar. The anusvāra is written as in modern Nāgri with a dot placed along, or sometimes above, the base line. The characters are all well-formed and beautiful to look at. The *language* of the inscription is Sanskrit. The opening four lines are a verse in the famous Sragdharā meter and the concluding lines a verse in Anuṣṭup. The rest are in prose. Grammatical mistakes are few in number and are probably due to the inscriber's ignorance of the language. Correct readings have been given at foot along with the text.

The inscription refers itself as already pointed out to Rāmasiṃha II, who is the twentieth king in the List of Jaintia kings given by Sir Edward Gait (see *Journal of the Asiatic Society of Bengal*, 1895, Vol. LXIV, part 1, page 246) His regnal years appear to have been from 1790 to 1813 A.D. The king, after having built a temple for Rāmeśvara-Śiva on the Kapota tilā (a small hill) in the existing village of Ḍhupī, makes a grant of land for the carrying on of his daily worship by Śrī-Rukhaḍa Paribrājaka or his disciples.

The inscription is dated Sunday, the month of Jyaiṣṭha, full moon day, śakābdā 1720 (1798 A.D.)

TEXT.

(*Edited from the original.*)

শ্রীদুর্গা ।

মিতা ৭[1] তা ২৮[2]

1. ওম্[3] সংস্থাপ্যাদ্রৌ কপোতেস্মরহরবিপুলঃ[4] শ্রীলরামেশ্বরাখ্যন্তং[5] সেবাদ্যর্থ
2. ভূমিঃ কিম্বতি পরিমিতা প্রার্পিতাস্মৈবূমার্কে । ভূপশ্রীরামসিং
3. হৈঃ খযুগলজলধিক্ষ্মাবিমানে[6] শকাব্দে সেবাদ্যাঃ কারণীয়াঃ
4. প্রতিদিনমনয়াকৃথড়েনাস্যশম্ভোঃ ॥[7] বিংশত্যধিকসপ্তদশশত
5. শকাব্দে কপোতাদ্রৌ মঠমন্দিরং দত্ত্বা রামেশ্বরাখ্য শিবলিঙ্গং সং
6. স্থাপ্য জয়ন্তীপুরপুরন্দরশ্রীশ্রীরামসিংহনৃপবরেণাষ্টখণ্ড
7. [8]পরি˘ ভূমিস্তন্নির্বাহার্থং তস্মৈ [9]সমপিতানয়া ভূম্যাশ্রীরূখড়পরি
8. ব্রাজকেন তৎশিষ্যোপশিষ্যেনাপি তন্নির্বাহাদিকং কর্ত্তব্যং কারয়িত

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[1] To be inserted after পরি in line 7.

[2] To be inserted in line 28 in place of the creeper design.

[3] Expressed by a symbol.

[4] Read °বিপুলঃ

[5] Read °রাখ্যস্তং

[6] The curve above the base line in বি has been omitted.

[7] Meter: স্রগ্ধরা।

[8] Read পরিমিতা°

[9] Read সমর্পিতা°

9. ব্যঃ[1] তদ্ভুমেরষ্টখণ্ডেন বিবরণং যথা। তদদ্রেরুত্তরস্যাং প্রথম
10. খণ্ডস্য পূর্ব্বদিশি [5]মুর্ত্তিধরদেশম্মুখ সম্বন্ধিভূঃ পশ্চিমস্যাং
11. সেতুঃ উত্তরস্যাং ডোম্বাতলভিট্ট্যাখ্যভূর্দক্ষিণস্যাং তদদ্রিরেতৎ[2]
12. ভূখণ্ডং জয়ন্তীপুররাজ্যান্তর্গত চৈলাখেলিনঃ সকাশাৎ শ
13. তদ্বয়কার্ষাপনেন[3] ক্রীতমিতি তদদ্রের্দক্ষিণস্থদ্বিতীয়খণ্ডস্যপূর্ব্বপ
14. শ্চিময়োঃ সেতুরুত্তরস্যাং নয়াখেলিনোভূর্দক্ষিণস্যাং তৎ
15. খেলিনো বাটিকৈ তৎভূখণ্ডং[4] তৎখেলিন আত্তং তদদ্রেঃ প
16. শ্চিমস্যাং তৃতীয়খণ্ডং [5]মূর্ত্তিধরসকাশাৎ চত্বারিংশদধিক
17. শতকাষাপণেন ষট্‌কেদারপরিমিতং ক্রীতং চতুর্থখণ্ডন্তনয়াখে
18. লিনঃ সকাশাৎ ষট্‌কেদারপরিমিতমাত্তং পঞ্চম খণ্ডং চতুষ্কে
19. দারপরিমিতং শ্রীজুড়াব্রাহ্মণাৎ ষষ্ঠিকার্ষাপণেন ক্রীতং
20. ষট্‌খণ্ডং খরিলরাজ্যান্তর্গতজগডুবীয়খলাখ্য দ্বাদশহলপ
21. রিমিতমেতস্যপরিবর্ত্তার্থাং[6] বরবক্রস্য সমীপবর্ত্তীয় তাপা
22. ই বিলাখ্যাবন্ত্যাং খলাঙ্গম্লেতৎ[7] খণ্ডমর্পিতং সপ্তমখণ্ডংবনবাউ
23. রভাগাখ্যভূমৌ চতুষ্কহলপরিমিতং সেনাপতি সকাশাদাত্তমষ্ট
24. মখণ্ডস্য পূর্ব্বস্যাং হাউলিধাসঙ্গকবিলং[8] পশ্চিমস্যাং গোভাডাখ্য ভূরুত্ত
25. রস্যাং শ্রীপুরাখ্যাবনির্দক্ষিণস্যাং বৃদ্ধলাখ্যভূমেরুত্তরসীমৌ [9]ত
26. ং ভূখণ্ডং মহাদেব্যাঃ সকাশাদাত্তমিতি ॥ শিবার্পিয়াং[10] যে
27. নাস্যামধিকারঃ ক্ষিতৌ নরঃ কর্ত্তব্যোঽভক্ষং[11] ভোক্তব্যং ভবিতা শিব
28. হাপি সঃ ॥[12] শকাব্দা[13] ১৭২০ মাসি জৈষ্ঠে[14] পূর্ণমাস্যাং

TRANSLATION.

(Salutation to) Śrī-Durgā.

Oṃ (expresssed in symbol). A temple of Śiva named Śrīla-Rāmeśvara having been established on the Kapota hill, some amount of land was endowed on Him by king Rāmasiṃha on Sunday in Sakabda, 1720 (expressed in astronomical language) for the purpose of His daily service (to be performed) by Rūkhaḍa (lines 1–4).

Having established a temple on the Kapota hill in 1720 and having set up a Śiva-phallus called Rāmeśvara (therein) the Purandara (i.e. king) of Jayantīpura, Śrī Śri Rāmasiṃha, the chief among kings, gave him eight plots of land for His maintenance (4-7).

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[1] Read কারয়িতব্যাং
[2] Read °এতদ্
[3] Read °কাষাপণেন
[4] Read °এতদ্°
[5] Read মূর্ত্তি°
[6] Read °অর্থং
[7] Read °অঙ্গাস্মেতৎ
[8] Read °সংজ্ঞক°
[9] Read তদ্°
[10] Read °অর্পিতায়াং
[11] Read °অভক্ষ্যং
[12] অনুষ্টুপ্
[13] Read তা, the omitted word, before শকাব্দা
[14] Read জ্যৈষ্ঠে

This duty of maintaining (Him) should be discharged with (the income from) this land by Mendicant (paribrājaka) Śrī Rūkhaḍa or by his disciples or by the disciples of his disciples. The description of this land (consisting) of eight plots is as follows (7-9) :—

To the north of this hill is the First plot which adjoins the land of Murtidhara, the Desammukha (literally, the chief of deśa or district)[1] in the east, and has in the west a ridge of earth (setu), in the north the land known as Dauyātalabhiṭṭi and in the south this (very) hill. This plot of land was purchased from the inhabitants of Chailā-khela in the province (rājya)[2] of Jayantīpura for Two hundred Kārṣāpaṇas (9-13).

The Second plot (lying) south of this hill has ridges in the east and west, the land of the inhabitants of Nayā-khela in the north and the houses of the inhabitants of that khela (i.e. village) in the south. This plot was taken away from the inhabitants of that khela (13-15).

To the west of this hill is the Third plot to the amount of Six kedāras purchased from Murtidhara for One hundred and forty kārṣāpaṇas; the Fourth plot measuring Six kedāras was but taken from the inhabitants of Nayā-khela ; and the Fifth plot to the amount of Four kedāras was purchased from the Brāhmaṇa Śrī-Juḍā for Sixty kārṣāpaṇas (15-19).

The Sixth plot to the extent of Twelve hālas is known as Jagaduvīyakhalā in the province (rājya)[3] of Kharil (which is) changeable for lands attached to the settled parts (khalāṅgāni) in the woody region of Tāpāibil near Baravakrā (20 22).

The Seventh plot to the extent of Four hālas in the land known as Vanabāurbhāga was taken from the Commander-in-Chief (22-23).

The Eighth plot has the marshy tract (vil) called Hāuliṣā in the east, the land called Gobhāda (? govāṭa) in the west, the region called Śrīpura in the north : in the south it is the northern boundary of the land called Briddhala. This plot was taken from the queen (mahādevī) (23-26).

He, by whom the endowments of Śiva are seized, would eat what is improper to eat and he would become a destroyer of good in this world (26-28).

Dated Śakābdā 1720, in the month of Jyaiṣṭha, on full moon day (28).

NOTES.

Political and Topographical.—The title " Purandara " assumed by the kings of Jaintia, is also to be found in their silver coins. The queen similarly had the title "Mahādevī." This is further clear from an inscription of queen Kāśāsati of Jaintia (to be shortly published).

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[1] See Notes. [2] See Notes. [3] See Notes.

The kingdom of Jaintia appears to have been organised into provinces called "rājyas." Thus, for example, this inscription tells us of two rājyas, namely, Kharil and Jayantīpura. The term "Deśammukha" (i.e. the Chief of Deśa) suggests that there were further subdivisions or districts called "desas," each under a ruler designated "Desammukha" (deśamukhya). The Marhatta government appointed officials under this designation (see also Sukraniti I, 374). In the districts or desas were groups of settlements called "khelas" or "khalās" corresponding to villages The word "grāma" (village) or "gāma" is also in vogue. I think there is distinction between a "khela" or "khalā" and a grāma The former being usually situated on elevated lands called tilās. lacks the compactness of the latter, and the homesteads of a khela are often scattered in the midst of cultivable tracts.

Almost all the places mentioned in the inscription, I am told, still go by the same names. I myself have visited some of these places Baravakrā is the old name of the modern Barāk River. The mention of this river may help us in forming an idea of the east and south-east boundary of the Jaintiarāj.

Economic.—The inscription makes it clear that the king was not the absolute owner of the whole land. He apparently exercised the right of ownership with regard to his "demesne" land only, such as the 2nd, 4th, 6th, 7th and 8th plots of land mentioned in the inscription, since he took away or resumed those lands from their occupants without paying a price. But on the other hand he had to purchase the lands taken from the inhabitants of Chaila-khele, Mūrttidhara, and Juḍā-brāhmaṇa

The gift as recorded in the plate is unconditional, the absolute ownership being transferred to god Siva, i e. the property is inalienable and free from any rent ordinarily payable to the king. This is thus an instance of Devottara.

Measurement of land according to Kedāra or Keyāra and Hala or hāla is still recognised thus :—

3 krāntis = 1 kaḍā
4 kaḍā = 1 gaṇḍā
20 gaṇḍās = 1 paṇa
4 paṇas = 1 rekhā
4 rekhās = 1 jaṣṭhi
7 jaṣṭhis = 1 poā
4 poās = 1 kedāra or keyāra
12 kedāras = 1 hala or hāla
= 10½ bighās
= 3½ acres.

The ordinary medium of exchange in the kingdom of Jaintia was kārṣā or cowries. There was also a silver money (coin) called Kāṭrā ṭākā which was priced at 4 as. according to the East India Company's standard of a sicca rupee (see *J.A.S.B.*, 1895. Vol. LXIV, Part I, pp. 242-3). Local custom fixes the value of a ṭākā or rupee in terms of cowrie thus :—

4 kārṣā or cowries = 1 gaṇḍā
20 gaṇḍās = 1 anna or paṇa

(Therefore, 80 cowries = 1 pana of kārṣā or 1 kārṣāpaṇa)

16 paṇas (or kārsāpaṇas) = 1 kāhaṇa (kārṣāpaṇa or kāhāpaṇa of silver) or ṭākā.

Kārṣāpaṇa or kāhāpaṇa was a very ancient form of money and it was issued both in silver and copper. The silver issues were called "rūpyarūpa" during the age of the Mauryyas (see Kauṭilya's Arthaśāstra, translation p. 92 and footnote 3). The copper issues are referred to in the Dharmaśāstras (Manu, viii, 134–8 : Yājñavalkya, I, 362-364 : Viṣṇu IV, 8–14). As far as my information goes no copper coin has yet been discovered in Jaintia, and the probabilty is that the Jaintia kings issued no copper coin, although they minted the silver pieces (kāṭrā ṭākā).

From the above data we may ascertain the value of land at that time in Jaintia in terms of the E.I. Co.'s money (sicca rupee) or roughly in our money (rupee) which is, however, a debased coin in comparison with the Company's :—

6 kedāras at 140 kārṣāpaṇa (lines 16–17) or Rs 8. 12 as.
.. 1 kedāra at Rs 1. 7⅓ as.
Again, 4 kedāras at 60 kārṣāpaṇa (ll. 18–19) or Rs 3. 12 as.
∴ 1 kedara at 15 as.

Now, if the kāhaṇa or ṭākā imply sicca rupee and not the kāṭrā ṭākā then the value of the kedāra would be reduced to ¼ of the amount, i.e. about 4 as. This is not very surprising, for, even now a bighā (⅞ of a kedāra or ⅓ of an acre) sells at from Rs. 5 to Rs 10. Price has gone up only twenty times after the lapse of a century and a quarter. Money has also become much cheaper now.

Religious.—This inscription together with a few more of the series shows the great influence exercised by the cults of Śiva and Śakti in this part of India, especially at a time when Bengal was being shaken to the very foundation, as a result of the waves of Christianity breaking upon her ancient superstructure of religious beliefs. This was the time when Raja Ram Mohan Roy was founding a new system of religious thought and the Christian Missionaries were making converts in number.

The inscription also shows the firm hold of Hinduism upon the non-Aryan Syntengs or at least upon their kings.

The present Mohānta tells me that Parivrājaka Rūkhaḍa was, as indeed the very name suggests, an up-countryman. Juḍā Brāhmana, (line 19) who was already a settler in Jaintia. is also apparently of the same nativity. The inscription of Baḍagosāyi (to be shortly published) too makes mention of a third up-countryman as the spiritual preceptor of the king. From these it would not be unreasonable to assume that the exponents of Hinduism in the Jaintia court were to a certain extent Brahmins from Upper India.

9. Maner Copperplate of Govindacandra, V.E. 1183.

By N. G. MAJUMDAR, M.A.

This copperplate comes from the village of Maner in the Dinapore Subdivision of the Patna District in Bihar. It was first noticed by Mr. R. D. Banerji, in his *Bāṅglār Itihāsa*, Vol. I, pp. 295–96, and the *Pālas of Bengal* (*Mem. A.S.B.* Vol. V), p. 106. Subsequently a paper containing the text and translation of the inscription as well as a rather indistinct photograph of the plate was published by Paṇḍit Rāmāvatāra Śarmā in the *Journal of the Bihar and Orissa Research Society*, Vol. II, pp. 441–47. As the Paṇḍit's article unfortunately contained many inaccuracies I drew up this note some two years ago. But I did not venture to publish it because my transcript was not based on an inspection of the original plate. I have since been told that the original plate cannot be traced at present. I therefore feel no hesitation now in placing my account before scholars for what it is worth.

This is a single plate inscribed on one face only. There is a circular seal attached to it, at the top. It bears the name *Śrīmad-Govindacandradeva* right across the centre, a device, which looks like a Garuḍa, just above it, and a *Śaṅkha* or conch shell at the bottom of the legend. The plate contains 26 lines of writing which seems to be well preserved. The characters are Nāgarī as in other Gāhaḍavāla grants and the language is Sanskrit.—The orthography calls for no special remarks excepting that *ś* is sometimes substituted by *s* e. g. *siva* for *śiva* (l. 17).—In the beginning there are nine well-known verses which invoke the blessing of the goddess Lakṣmī and give the genealogy of the dynasty up to Govindacandra. At the end again we find as many as eleven benedictive and imprecatory verses, and the name of the scribe in prose. The formal part of the grant recording the donation runs from line 8 to line 19.

The inscription is one of the *Paramabhaṭṭāraka Mahārājādhirāja Parameśvara* Govindacandra, son and successor of the *P.M.P.* Madanapāla, who was the son and successor of the *P.M.P.* Candradeva. The grant records that on *Sunday, the 11th of the dark-half of the month of Jyaiṣṭha of the* (*Vikrama*) *year* 1183 (expressed both in words and decimal figures), he granted the villages of Guṇāve and Paḍalī in the Maṇiari-*pattalā* to a Brāhmaṇ named Gaṇeśvaraśarman, grandson of *Ṭhakkura* Śiva and son of *Ṭhakkura* Deḍama, belonging to the Kāśyapa *gotra*, after bathing in the Ganges at Kānyakubja. The taxes herein specified, which were the source of revenue to the grantee, are *bhāgabhogakara*, *pravaṇikara* and *Turuṣkadaṇḍa*, which are generally to be found in almost all the grants of the Gāhaḍavāla dynasty.

The grant was written by the scribe (*Karaṇika*) *Ṭhakkura* Śrī-Viśvarūpa. He is most probably the same as the scribe of the Ren,[1] the Raiwan[2] and the Lucknow Museum plate of Govindacandra,[3] and also one of Govindacandra's Kamauli plates.[4] The date is regular. The 11th *tithi* of Jyaiṣṭha, Vadi of the Vikrama year 1183 (current) corresponds to Sunday, the 11th May, 1124 A.D.[5] Regarding the localities mentioned in this inscription, Maṇiari is the same as modern Maner, where it was found in the possession of a Brāhmaṇ family. The Maṇiari-*pattalā* herein mentioned is evidently the same as the Mā[na]ra-*pattalā* of the Benares College copperplate of king Jayaccandra[6], son of king Govindacandra, dated 1232 V.E., i.e. 1175 A.D. Guṇāve and Paḍalī must lie somewhere close to the present village of Maner; but these two localities I am unable to identify.

This record supplies one more proof of the Gāhaḍavāla occupation of Magadha towards the end of the Pāla dynasty. The Pāla sovereignty, over at least a portion of Magadha must have collapsed before 1124 A.D., the date of the Maner plate, because in that year the Gāhaḍavāla king Govindacandra made a grant of land in the district of Patna. At various dates between the years 1124 A.D. and *circa* 1180 A.D. we find the Gāhaḍavālas ruling over Aṅga and Magadha. The Lār plates of Govindacandra[7] dated A.D. 1146 prove that he had by that year advanced as far as Mudgagiri or Munger. There are indications that the occupation was by no means a temporary one. In 1169 A.D., as the Tārācaṇḍī inscription of Pratāpadhavaladeva[8] shows, the Gāhaḍavālas in the reign of Vijayacandra were occupying a territory, which included at least the Shāhābād District. Then we have the evidence of the Benares College copperplate of Jayaccandra dated 1175 A.D. In that year he granted a village in the Mā[na]ra-*pattalā* which I have identified with Maṇiari-*pattalā* i.e. modern Maner, in the Patna District. Jayaccandra was also the master of the neighbouring district of Gayā as appears from his Bodhgayā inscription, dated *circa* 1180 A.D[9]. The rise of the Gāhaḍavālas may therefore be regarded as one of the greatest factors that finally brought about the decline of the Pāla power. As I have shown elsewhere (*Ind.Ant.*, 1919, p. 46) no definite proof has yet been adduced which can connect the rule of the Senas of Bengal with Bihar. The successors of the Pālas in Magadha and Aṅga were not the Senas, as is commonly supposed, but the Gāhaḍavālas.

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[1] *Ind. Ant.*, Vol. XIX, p. 252.

[2] *Ibid.*, Vol. LVI, p. 113.

[3] *Ep. Ind.*, Vol. XIII, p. 297.

[4] *Ep. Ind.*, Vol. IV, p. 111, No. I.

[5] I am indebted to Mr. N. K. Majumdar of the Calcutta University for the above calculation.

[6] *Ind. Ant.*, Vol. XVIII, p. 131, l. 20.

[7] *Ep. Ind.*, Vol. VII, p. 98.

[8] *Journ. Amer. Orient. Soc.*, Vol. VI, p. 548.

[9] *Proc. A. S. B.* 1880, p. 78.

EXTRACTS FROM THE TEXT.

L. 11 .... [1] Śrīmad = Govindacandradevo vijayī Maniari-*pattalāyāṁ* Guṇāve-saha-Paḍalī-grāma-nivāsino nikhila-janapadān = upagatā-

12. n = api ca rāja-rājñī-yuvarāja-mantri-purohita-pratīhāra-senāpati-bhāṇḍāgārik-ākṣapaṭalika-bhiṣag-naimettik-āntaḥpurika-dūta-kari-turagapaṭtanākarasthānagokulā =

13. dhikāri-puruṣāṁś = c = ājñāpayati bodhayaty = ādiśati ca yathā viditam = astu bhavatāṁ yath = oparilikhita-grāmaḥ sa-jalasthalaḥ sa-loha-lavaṇ-ākaraḥ sa-matsy-ākaraḥ sa-gart-oṣaraḥ

14. sa-madhūk-āmra-vana-vāṭikā-viṭapa-tri(tṛi)ṇayūti gocara-paryantaḥ s-orddh[v*]-ādhaś = catur-āghāṭa-visuddhaḥ[2] sva-sīmā-paryantaḥ *ttryasīty*[3]*-adhik-aikādaśa-śata-saṁvatsare Jyeṣṭhe māsi kṛiṣṇa paks-aikā-*

15 *daśyāṁ Ravidine =* 2 *ṅkataḥ saṁvat* 1183 *Jyaiṣṭha-vadi* 11 *Ravau* Śrī = Kanyakubje Gaṁgāyāṁ snātvā vidhivan = mantra-devamuni-manuja-bhūta-pitṛi-gaṇāṁs = tarpayitvā timira-paṭala-pāṭana-paṭumahasa-

16. m = Uṣṇarociṣam = upasthāy = Auṣadhipati-sakala-śekharaṁ samabhyarcya tribhuvana-trātur = Vvāsudevasya pūjāṁ vidhāya pracura-pāyasena haviṣa huvirbhujaṁ hutvā mātā-pittror = ātmanaś = ca pu-

17. ṇya-yaśo-bhivṛiddhaye = smābhi gokarṇa-kuśalatā-pūta-karatal-odaka-pūrvaṁ Kāśyapagottrāya Kāśyap-Āvatsara-Nidhruva-triḥpravarāya Ṭhakkura Siva[4]-pauttrāya Ṭhakkura-Deḍama-

18. putrāya Ṭhakkura-śrī-Gaṇeśvaraśarmaṇe Brāhmaṇāy = ācandrārkkaṁ yāvac = chāsanīkṛitya pradatto matvā yathā-dīyamāna-bhāgabhoga-kara-pravaṇikara-Turuṣkadaṇḍa-prabhṛiti-sarvv-ādāyā-

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[1] Up to this the text is exactly the same as in the Kamauli plate of Govindacandra, dated V.E. 1182, *Ep. Ind.*, Vol. IV, pp. 100–101.

[2] Read *viśuddhaḥ*.

[3] Read °*śīty*.

[4] Read *Śiva*.

19. n=ājñāvidheyībhūya dāsyath=eti ‖ ccha ‖
Bhavanti c=ātra ślokāḥ[1]....................
26 ....Likhitaṁ c=edaṁ tāmrapaṭṭakaṁ karaṇika-ṭhakkura-Śrī-Viśvarūpen=eti.

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[1] Here follow the eleven verses beginning with *Bhūmiṁ yaḥ pratigṛihnāti*, *Saṁkhaṁ bhadr-āsanam*, *Sarvvān=etān bhāvinaḥ*, *Bahubhir=vasudhā*, *Gām=ekāṁ*, *Taḍāgānāṁ sahasrānāṁ*, *Sva-dattāṁ para-dattāṁ vā*, *Ṣaṣṭi-varṣa-sahasrāni*, *Vārihīneṣv=araṇyeṣu*, *Yān–iha dattāni*, and *Vātābhra-vibhramam*

10. On the "Renal Portal" System (Renal Venous Meshwork) and Kidney Excretion in Vertebratata.

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[NOTE. A word of explanation regarding the composition of this Memoir is necessary. The Memoir is based upon the results of five years' work and as originally submitted for publication (in England) contained complete evidence for every one of my statements and was of the dimensions of a book. The cost of publication prohibiting publication of papers of this size, I was induced to re-submit it in the form of an abstract, omitting all details of experiments, whereupon experts complained that I had not submitted proofs of my statements! I now adopt a middle course and while publishing the Memoir in a very abridged form, I provide the details of a few of the more important experiments in the form of Appendices. This is absolutely necessary, since the Memoir not only ventures to correct the misstatements of several well-known physiologists but questions both the widely-accepted theory of kidney secretion recently rehabilitated in Cushny's "The Secretion of Urine", 1917, and the still more widely-accepted view that the glomerulus filters off or secretes at least the water of the urine. I may add that, residing in Allahabad, India, I am wholly unacquainted with literature published subsequently to 1917 and possibly with some important papers published previously to that year.]

PART I

ON THE TWO SYSTEMS OF SINUSOIDS IN THE FROG'S KIDNEY.

Introduction.

There exist two well-known examples of organs being supplied by a vein in addition to an artery, viz. the hepatic portal vein supplying the liver, and the so-called "renal portal" vein "supplying" the kidney of the majority of the lower vertebrates. Since the former is known to be all-important in connection with the hepatic function, it has not unnaturally been assumed by physiologists that the so-called "renal portal" vein must at least play some part in connection with the renal secretion. On the basis of this assumption, physiologists have further assumed that the "renal portal" vein joins on to and forms an important part of the intertubular plexus system of vessels present in the kidneys of lower vertebrata—the only system of vessels the vein could join.

Certain considerations however exist which lead us to doubt the first assumption. As I have previously pointed out in 1906 (44, 45), [1] such facts as that (1) "portal" kidneys (i.e. provided with "renal portal" veins, which, on the hypothesis, can only be regarded as aids to excretion) are only found in the relatively sluggish cold-blooded Anamnia and not in the active hot-blooded Amniotes; that (2) "portal" kidneys are not larger in size than non-portal kidneys (well seen when kidneys of both kinds co-exist in the same individual), though the former receive, on the "portal" hypothesis, at least four times (Indian frog—see Appendix A) as much blood as the latter; that (3) of the venous blood returned from the legs and pelvic region, from one-third to one-half evades the passage of the kidneys (see Appendices A and D), traversing the anterior abdominal vein instead of the two "renal portal" veins (and of the venous blood which does enter the renal afferent veins, only about one-fifth comes into contact with the kidney tissue, the remainder passing direct from the renal afferent into the renal efferent veins—vide *infra*, p. 10—whereas in the liver every drop of the venous blood in the hepatic portal vein is compelled to flow through the portal capillaries; that (4) the development of the hepatic portal system is fundamentally different from the development of the "renal portal" system (renal venous meshwork), the former arising by the active penetration of the venous blood channels into all parts of the hepatic mass, while the latter is

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[1] All literature references will be given at the end of Part IV.

CORRECTION SLIP.

Page 27. *Line* 8, *for* in, *read* into.

,, 27. *2nd line of foot-note, for* Pewsha, *read* Peshwa.

,, 33. *Line* 8, *for* 41, *read* 56.

,, 34. ,, 17, ,, Uually, *read* Usually.

,, 35. ,, 36, ,, 1, p. 4 ,, 3, p 51.

,, 38. *Bottom,* খাতি দিন & জাতিঁ দিন *read* খাতি দিল & জাতি দিল.

,, 40. *Line* 18 *of foot-note, for* 14, *read* 35.

,, 40. *Insert at bottom* "Plate I (1) shows the appearance of the Hashnabad Church at the present day."

,, 52. *Line* 20 *of foot-note-for* 1841, *read* 1641.

,, 53. *Lines* 13, 15, & 28 *of foot-note, for* (Katrabo), Manaswar & '4, p. 35' respectively, *read* (Katrabo ?), Maneswar & '2, p. 51.'

,, 57. *In* "Historical Précis * * * Eastern Bengal" under 'Appendix III' *omit* the quotation marks.

,, 58. *Line* 1, *put* 'chiefly' *between* 'years' & 'collected.'

,, 59. *Line* 4 *of last para., for* 38, *read* 54.

,, 60. *Lines* 8, 13, 14 & 15, *for* government, government, christians, and government respectively, *read* Government, Government, Christians & Government.

,, 60. *Below* "by 5·8 %." *insert* "Recd. May 1921" (with proper date of month).

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merely the "result of the penetration of the nephridia [kidney tubules] into the cardinal vein" (38)—the penetrating activities of the blood and organ tissues are reversed in the two cases; and that (5) whereas the liver continues to secrete bile in a normal fashion for a long time after the hepatic artery has been ligatured, the kidney, on the other hand, ceases secretion immediately the arterial supply is stopped, and, whereas bile secretion is at once arrested if the portal vein be occluded, kidney excretion remains unaffected when the venous supply is eliminated, all furnish evidence in favour of the view that the venous "renal portal" supply plays no part whatever in connection with kidney excretion—a view which will be amply confirmed by the evidence supplied in the first three Parts of this memoir.

If then, the common assumption that the "renal portal" system is of some use in connection with renal excretion be open to doubt, it may well be questioned whether the further assumption almost universally held by physiologists, viz. that the intertubular plexus of the "portal" kidney is traversed by a mixture of venous and arterial blood, is not also open to doubt. This appears to be the more probable since Hyrtl so long ago as 1863 (26), described *two* systems of blood vessels in the frog's kidney (the coarse network of large venous channels derived from the "renal portal" or renal afferent vein, and the fine network of minute arterial capillaries derived from the efferent glomerular arteries), and Vialleton (42) has more recently confirmed this observation for the kidneys of sharks. Further, as I shall prove, the evidence on which physiologists base the assumption that venous blood traverses the intertubular capillary plexus is extremely faulty. I may here remark that the solution of this problem as to whether or not the venous blood traverses the intertubular plexus of the frog or other "portal" kidney is of supreme importance, because, as the following pages will show, the demonstration of the fact that venous blood does *not* traverse the minute capillary-like sinusoids which alone supply the tubules, provides evidence which enables us to state definitely that in the kidney it is the tubules alone which secrete the urine, the encapsulated glomeruli taking no direct part (see Part IV).

The Current Opinion concerning the Construction of the "Portal" Kidney is ill-founded.

The assumption (almost universally adopted by physiologists) that the venous blood in the renal afferent vein mixes with the arterial blood derived from the efferent glomerular arteries and therefore traverses the intertubular plexus is based on the results of oft-repeated dye injection experiments. It has been stated on many occasions that whether dye be injected via the renal afferent vein or via the renal arteries, the result is that the dye is always to be found in the sinusoids of the intertubular plexus. But it is evident that if we have in the "portal" kidney two distinct, though mechanically intermingled, systems of sinusoidal channels—the fine intertubular plexus conveying arterial blood and the coarse renal venous meshwork ("renal portal" system) conveying venous blood entirely separate from each other save for the communications[1] by means of which the intertubular plexus pours its arterial blood into the renal venous meshwork on its way to the renal efferent veins, then *it is all essential that in dye-injection or perfusion experiments we should maintain the same relative fluid pressures in the two systems of channels as exist in life.* It is evident that if this condition be not fulfilled, then the dye which, if injected via the renal afferent vein, should only appear in the channels of the renal venous meshwork, will, owing to the excess of pressure in the vein, penetrate into the intertubular plexus, which, under normal conditions does not contain venous blood, and *vice versa.* It is thus useless to rely upon the results of dye experiments in which the relative and absolute fluid pressures of the dye-injection fluids in the two systems of channels have not been ascertained to be similar to those of the venous and arterial blood pressures in the kidney of the living animal, and worse than useless to consider the results of experiments in which dye was only injected through one vessel at a time[2] No previous dye injection experiments known to me satisfy these conditions of fluid pressure, nor do previous investigators appear to have realized the necessity of insisting upon these conditions I may mention however that some "double injection" experiments of Bainbridge, Collins and Menzies (4) apparently happened to fulfil more or less these pressure conditions, since their results are strictly in accordance with the results obtained by me. I quote these authors' description of their experiments. "The fluids used consisted of (a) Berlin blue, and (b) carminate of Ammonia, in Ringer's solution. A few double injections were made, carmine by the arteries and Berlin blue by the renal portal veins. One gelatine double injection was also made, but in this case the pressure used was obtained by means of an injecting syringe [!] and pressure bottle and was higher than usual. It was found that whether the *single*[1] injection was made by the artery [aorta] or by the renal portal vein, *the whole of the intertubular capillary network appeared to be injected.*[1] In the case of the double injections [arterial bottle head of fluid = 20–24 cms. pressure, and "renal portal" vein bottle head of fluid = 10–12 cms.], the glomeruli and efferent vessels were filled with the arterial injection fluid, whereas *the intertubular capillaries showed, some the arterial fluid, some the venous, and some a mixture of both.*"[1] Thus these results alone, imperfect as the experiments were, afford some evidence in favour of the view that the "intertubular capillaries" really consist of two distinct kinds of vessels (since if the arteries and veins opened into a common plexus, *all* the constituent "capillaries" would be filled with a purple mixture)—those filled with "arterial fluid" (the intertubular plexus proper), those with "venous" (the renal venous meshwork) and those with "a mixture of both" (the distal portions of the renal venous meshwork into which the intertubular capillaries have opened).

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[1] "Die Batrachiernieren ...bei welchen der Übergang der Arterien in Venen nicht durch successive Grössenabnahme der Arterie vorbereitet wird, sondern plötzlich feinste Arterien in dicke Venenwurzeln einmünden." (Hyrtl, 26, p. 175.)

[2] For example, Bainbridge, Collins and Menzies (4) successively perfused 1/10,000 mercuric chloride, saline and a weak saline solution of ammonium sulphide through the renal afferent vein alone under 10 cms. pressure, and mercuric sulphide was actually found in some of the glomeruli ("the glomeruli remained free from it in the vast majority of cases") even under this relatively low pressure. I have obtained similar results with indigo-carmine saline perfusion at 12 cms. pressure, but not at 10 cms. or 7·5 cms. pressure.

Conditions essential for the Conduct of trustworthy Dye-injection Experiments.

It is evident that fluid pressure in any given system of blood vessels perfused from a perfusion bottle depends not only on the pressure head of the fluid in that bottle but also on the calibre of the cannula nozzle tied into the artery or vein and the resistance to outflow of the fluid from the system of blood vessels. In my early perfusion experiments on the frog I, like previous investigators merely maintained the height of the fluid in the aortic perfusion bottle 24 cms. above the level of the aorta, and the height of the fluid in the renal afferent vein bottle 10 cms. above the level of the vein, and it was only when I discovered that, under these conditions, the relative flows of fluid through the aorta and each renal afferent vein respectively were very different (the flows via the renal afferent veins always being excessive relative to the aortic flow) from the flows obtaining in the normal frog that it occurred to me to take the cannula nozzle calibres into consideration. Assuming that the maintenance of correct relative flows of fluid through the renal arteries and renal afferent vein of each kidney will ensure the maintenance of correct relative fluid pressures in the renal venous meshwork and intertubular plexus, I ascertained (see Appendix A) in five perfusion experiments (1) that in the normal Indian frog (*Rana tigrina*) the flow (volume of fluid passed in a unit of time) of fluid in each renal afferent vein is about 1/3, and, to avoid all possibility of any excess of venous pressure, should be maintained at not more than 1/4, of the flow through the aorta; and (2) that the flow through each renal afferent vein is about three times the flow through the renal arteries supplying each kidney, i.e. the venous supply of the kidney of the Indian frog is about three times as great as the arterial supply. To reproduce these relative flows in perfusion experiments in the Indian frog (average specimens of which are about ten times the weight of an average specimen of *Rana temporaria*) I selected a cannula for the aorta with a flow of about 70 c c. per minute at 24 cms. pressure, and two cannulae for the two renal afferent veins, each with a flow of about 10–12 c.c. per minute at 24 cms pressure. Using these cannulae I raised the aortic perfusion bottle to 24 cms. pressure, and adjusted the heights of the two renal afferent vein perfusion bottles (usually between 4 cms. and 7 cms.) so as to give equal flows, each approximately one quarter of the flow from the aortic bottle. Apart from the calibres of the cannula nozzles I found that, to obtain correct relative flows, the heights of the renal afferent vein perfusion bottles had also to be adjusted in connection with the osmotic pressure of the renal afferent vein fluid relative to that of the arterial fluid (see Appendix C), and with the size of the frog's body [1]—the greater the osmotic pressure of the renal afferent vein fluid relative to that of the arterial fluid and the larger the frog, the more "head" of fluid required in the renal afferent vein bottles

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[1] My Italics.

Another essential condition in these, as in all other perfusion experiments, is for the perfusion fluid besides being approximately isotonic to blood, to contain sufficient dissolved oxygen to supply the needs of the kidney cells Thorough aeration of the fluid is sufficient for this purpose, as was proved by the facts that most of the results obtained from perfusion experiments have been confirmed by those obtained from experiments on the living animal, and that the urine secreted by the kidneys in these experiments always differed in total nitrogen and chloride strengths from the perfusing fluid, i.e. the urine was not a mere filtrate. The investigations of Vernon (41), which prove that the *mammalian* kidney can remain in a living healthy condition (as determined by gas metabolism results) after perfusion with saline at room temperature (therefore much lower in this case than the body temperature) for at least eight or nine hours and can retain its vitality even when wholly deprived of oxygen for a much longer period, afford a sufficient answer to the off-hand criticism that the results of perfusion experiments on the kidney must be unreliable, owing to the kidney cells being necessarily in a condition of "partial asphyxia" and therefore unable to function normally. It is moreover remarkable that those who advance this criticism, even in connection with experiments on cold blooded animals, are those who also maintain that, in the living frog, three-quarters of the blood supplying the tubules is venous, and that "the tubules continue to receive a more or less adequate supply of blood if... the renal arteries... are ligatured" (Cushny, 17, p. 75), though this last statement is in direct opposition to the results of the experiments of Schmidt (36) and Beddard (8). Finally, it may be remarked that the well-known experiments of Bainbridge and Beddard (3) (designed to remedy the deficiency of oxygen due to the absence of the arterial blood supply by keeping some of the frogs in an atmosphere of oxygen and so arterializing the venous blood in the renal afferent veins) in reality afford no proof at all of the necessity of employing oxygenated perfusing fluids, if, as I maintain, the fluid in the renal afferent veins does not normally come into physiological contact with the tubules (the secretion obtained by these authors merely resulting from an overflow of the venous blood, highly charged with diuretics, into the empty intertubular plexus). It is a curious fact that though the results of these experiments are universally quoted as evidence of the necessity of oxygenating (as distinct from merely aerating) the perfusing fluid, yet the results themselves, when analysed, actually prove that air dissolved in the blood (or perfusion fluid) is just as efficient as oxygen Thus in the twenty-two experiments recorded by these authors, 7 frogs kept in *air* for periods amounting in the aggregate to 27 days, and injected altogether with 38 c.c. of diuretics, secreted about 9 c c. of urine, whereas 15 frogs kept in *oxygen* for periods amounting in the aggregate to 46 days and injected altogether with 74 c c. of diuretics, secreted about 22·5 c.c. urine: from which data it is certainly unjustifiable to conclude that the oxygen had any greater effect in inducing the kidneys to secrete than ordinary air—aeration of the venous blood was just as effective as oxygenation

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[1] I can only explain this by supposing (the aortic bottle pressure remaining constant in my experiments) that the smaller the body of the frog, the greater becomes the arterial pressure relative to the transmission-capacity of the frog's blood vessels. The intertubular plexus is shielded to a large extent from this excessive pressure by the glomeruli (which are essentially pressure reducers) and the renal venous meshwork to a *less* extent by the leg capillaries—the result being that the flow through the renal afferent vein becomes excessive relative to that through the intertubular plexus.

I may here add that in all experiments the frog was operated on from the dorsal surface, that all dorso-lumbar veins and all small muscular and cutaneous arteries arising from the aorta were carefully ligatured, that the lymph hearts posterior to the kidney were extirpated, that the ureters were in every case dissected out (an easy operation with practice) and the extremities allowed to rest inside the necks of glass collecting tubes (the insertion of cannulae into the ureters is unnecessary).

The Dye-Injection of the Kidney of Rana tigrina *under Normal Conditions of Fluid Pressure.*

In all I performed thirteen satisfactory experiments [1] with absolutely and relatively correct flows via the two renal afferent veins and the renal arteries. In all the experiments 0·6% saline was perfused, 20 c c. of stock fresh human urine [2] being added to each 2000 c.c of the aortic saline, and 46 c.c. of the same stock of human urine being added to each 2000 c.c. of the renal afferent vein saline (vide infra). In six of the experiments indigo-carmine was dissolved in the *aortic* saline so that it became ink like, and in the remaining seven experiments the indigo-carmine was introduced into one of the renal afferent veins. After the dye had been perfused for some minutes (at least ten minutes and usually longer), all the vessels connected with the kidneys were ligatured *simultaneously* and these, with the kidneys plunged into absolute alcohol. In the experiments with the dye in the renal arteries the urine secreted from both kidneys was ink-like, but in the seven experiments in which the dye was present in one of the renal afferent veins, the urine of the kidney supplied by that renal afferent vein remained practically colorless, only the faintest blue-tinge being detectable (due to diffusion and not to excretion of the dye). The fluid flowing forward in the post-caval in these latter experiments was ink-like on the side next the dye-injected kidney and colorless on the other side.

On examining horizontal sections of the artery dye-injected kidneys, dye was found to be present in every glomerulus (though entirely absent from the cavities of the capsules), in the minute capillaries in intimate contact with the walls of the tubules and in the lumina of many tubules. Granules of dye were also occasionally to be detected inside the cells of the convoluted tubules (text-figure 1,A). Dye was completely absent from the large sinusoids which lie between the tubules. Horizontal sections of the renal afferent vein dye-injected kidneys; on the other hand, showed that dye was absent from all the kidney tissues save the large renal venous meshwork

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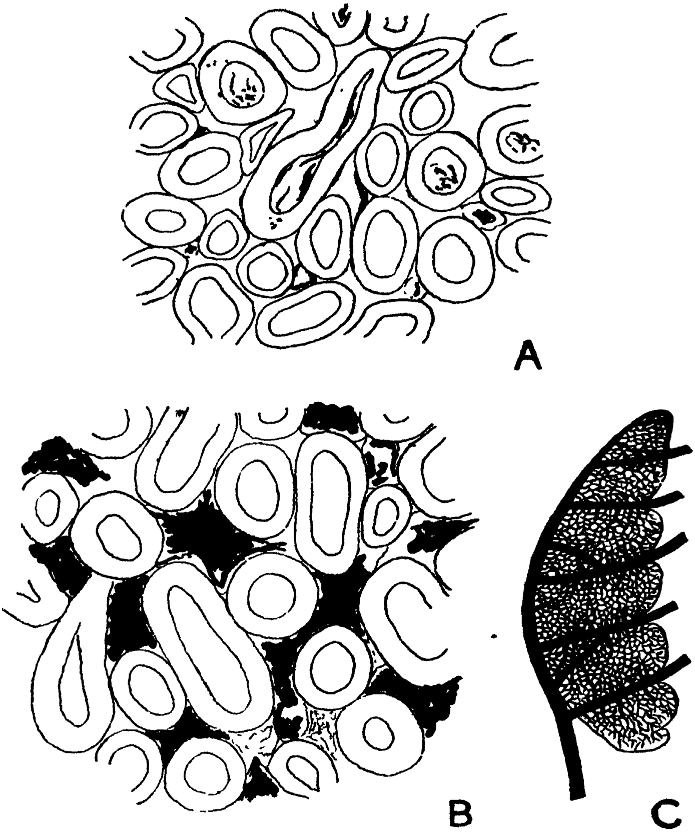
[1] In this abridged statement of my results I am unable to supply the details of all the experiments owing to considerations of space, but I shall be pleased to send these details, both of these and of all other experiments referred to in this paper, to any body who may wish to inspect them.

[2] At this time (1918), I "nitrogenized" the perfusion fluids by adding definite quantities of fresh human urine of uniform composition because I was unable to obtain urea crystals.



TEXT-FIGURE 1. Comparison of sections of artery and vein dye-injected frog kidneys.

A (× 330) Camera lucida drawing of a piece of a section across a kidney injected with indigo-carmine via the renal arteries. Ink-like urine was being excreted. Dye was present in various amounts in all the glomeruli, but none in the capsules (in which position I have never observed it; though if it occurred I should attribute it to inflow from the tubule lumen). Dye was present in many of the intertubular capillaries and in the tubule lumina, and occasionally (rarely) granules of dye could be detected in the convoluted tubule cells. No dye was present in the large intertubular spaces (venous sinusoids).

B (× 330) Camera lucida drawing of a similar piece of a section across a kidney similarly injected with indigo-carmine but via the renal afferent vein. The urine was practically colorless. Dye was entirely absent from the glomeruli, capsules and tubule lumina and cells, but was present in large quantities in the large intertubular sinusoids.

These two sections clearly demonstrate the existence of two distinct and separate systems of channels traversing the kidney substance—the fine network of narrow arterial intertubular channels (intertubular plexus) and the coarse meshwork of large venous intertubular channels (renal venous meshwork). If these two systems of channels constituted a single sytem (as assumed in current literature) the dye injections of both kidneys in the region of the tubules would have been similar in appearance, the only difference being one of quantity.

C (× 5) Diagram (constructed from serial horizontal sections of the kidney injected with carmine via the renal afferent vein) of the renal venous meshwork of the frog's kidney (*Rana tigrina*). The presence of the large interlobular channels connecting the renal afferent vein with the efferent renal veins shows that only a very small proportion of the venous blood in the renal afferent vein itself actually traverses the network of sinusoids.

channels (text figure 1.B). These results thus afford ocular demonstration of the fact that two separate and distinct systems of vessels traverse the substance of the "portal" kidney —one which is normally filled with (arterial) fluid from the renal arteries and one which is normally filled with (venous) fluid from the renal afferent vein. When dye is present in the system containing arterial fluid (the intertubular plexus—homologous with that of non-portal kidneys), the dye appears in the urine; when dye is present in the system containing venous fluid (the renal venous meshwork), the dye is not excreted into the urine. This is but one of the many proofs which can and will be adduced to show that the venous supply of the kidney is not associated in any way with kidney excretion.

Another result of these dye-injection experiments was to confirm the observation made by Hyrtl (26), that in the frog's kidney, the renal afferent vein situated on the dorsal side is put into direct communication with the renal efferent veins on the ventral side by means of five or six large interlobular channels, the blood in which therefore does not traverse the renal venous meshwork proper (text fig. 1, C). Thus of the venous blood in each renal afferent vein, at least four-fifths passes through these connecting channels and so does not come into contact with the kidney substance. This again is proof that the association of the renal afferent vein with the kidney must be of very little importance—if the kidney (which has a larger arterial supply, relative to its bulk, than any other organ in the body) needed venous blood, it is not likely that it would be "content" with the aid of a few microscopic venous sinusoids, but, like the liver, would require at least the whole vein. The fact that only a very small proportion of the venous blood actually traverses the kidney substance is also demonstrated when, in a living frog, one renal afferent vein is ligatured—the substances of the two kidneys remain exactly the same red colour, although one is supplied with bright red arterial blood alone and the other with dark blue [1] venous blood three times the volume of the arterial [2]

Variations in the Composition of the Fluid traversing the Renal Venous Meshwork have, apart from certain Exceptions to be stated, no Effect on the Composition or Quantity of the Urine, provided that correct Relative Flows be maintained.

Though it has been demonstrated in the previous Section that, with correct relative flow, the fluid in the renal afferent vein is restricted to the renal venous meshwork and does not "supply" the tubules and that the presence of indigo-carmine dye in the renal afferent vein fluid has no effect on the urine, yet it is necessary, both in order to emphasize the physiological apartness of the "renal portal" system from kidney activity, and to bring forward new facts, to describe the results of further experiments.

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[1] Not scarlet or even purple, as one might suppose from Cushny's figures 14 and 15 (17).

[2] This same fact is observed when in a double perfusion experiment

It is well known that venous blood has a higher osmotic pressure than arterial blood, and it is evident that the reason for this in the cases of the renal afferent vein blood and renal artery blood is that, during its circulation between the iliac arteries and the renal afferent veins, the former has added to it the nitrogenous waste matter from the tissues of the legs.[1] If we divide the tissues of the body of a frog into (1) those which eliminate their waste nitrogenous matter directly into the blood which enters or may enter the two renal afferent veins (tissues of legs, thigh region and posterior portion of the back), and (2) those (the tissues of the rest of the body) which pour their waste nitrogenous matter into all other veins, we can distinguish the increase of nitrogenous contents of the blood per unit volume in each cycle of the circulation due to the former class of tissues by P, and the similar increase due to the latter class of tissues by B. It will then be evident, leaving out of consideration the amounts of nitrogenous matter abstracted by the kidneys from the blood in the renal arteries, and, we will suppose, from the blood in the renal afferent veins, in each cycle of the circulation, that $\frac{\text{the nitrogen strength of renal artery blood}}{\text{the nitrogen strength of renal afferent vein blood}}$ is represented by the formula $\frac{P+B}{2P+B}$, i.e. the renal afferent vein blood is stronger in nitrogen than the renal artery blood by P. Now if we assume that P and B are proportional in value to the weights of the tissues producing them (and, apart from the skeletal and connective tissues, this assumption may be taken as roughly correct), all that we have to do in order to ascertain the relative strengths of renal artery blood and renal afferent

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with correct flows indigo-carmine is perfused through the renal afferent vein of one kidney, that kidney appears to the eye to be stained a dense blue-black, but if it be fixed in alcohol, it can be seen that the dye has in reality hardly affected at all the colour of the mass of the kidney tissue, only the large sinusoids being stained. This effect may in part be due to the renal venous meshwork being restricted to the deeper parts of the kidney. On the other hand, when, in a living frog, the anterior abdominal vein is ligatured and the two renal afferent veins contain much more blood than usual, the kidneys become markedly darker in colour.

[1] If saline be perfused through the limbs, the saline returning via the renal afferent (or anterior abdominal) veins will be found to contain an increased percentage of nitrogen.

vein blood in excretable nitrogenous matter is to weigh, in individual frogs, the masses of tissue which produce P and B respectively, viz. the weights of (1) the legs, medio-dorsal trunk muscles and skin, and the posterior part of the vertebral column; and (2) the rest of the body. These two weights—(1) and (2)—were approximately determined in eight normal female *Rana tigrina*, with the average result that $\frac{P+B}{2P+B}=\frac{3}{4{\cdot}6}$ We assume then that in the normal *R. tigrina* the blood in the renal afferent veins is stronger in excretable nitrogenous matter than the blood in the renal arteries in the approximate ratio of 4·6 : 3, and this condition was fulfilled in all my ordinary perfusion experiments (vide the 30 and 46 fluids of the dye-injection experiments referred to in the last Section). In sixteen experiments [1] which I conducted in order to ascertain whether the substitution of 30 fluid for 46 fluid or vice versa in the renal afferent veins made any difference to the nitrogen composition or quantity of the urine secreted, I found that this was not the case, provided that the 30 fluid perfused through the renal afferent vein or veins was made osmotically equal in strength to the 46 fluid by the addition of a little extra sodium chloride (see p. 16 below). This condition being fulfilled and the flows being correct, urine samples obtained when the renal afferent veins were filled with 30 and with 46 fluid respectively were identical in nitrogen strength [2] and quantity. And I obtained the same results as regards the nitrogen strength of the urine when the nitrogen strength of the renal afferent vein fluid was twice (60) and even three times (90) as great as that of the arterial fluid (30), though the urine was produced in greater quantity when the nitrogen strength (and therefore osmotic pressure) of the renal afferent vein fluid was greater than in the proportion of 46 : 30. In all these experiments, with the " pressure head " in the arterial perfusion bottle at 24 cms, the urine contained a greater percentage of nitrogen than the arterial fluid (proof that the " urine " was not a mere filtrate). In one experiment I lowered the aortic bottle to 18 cms. and obtained urine of a nitrogen strength of 0·000253 gm. per 1 c.c, the arterial fluid having a nitrogen strength of 0·000093 gm. and the 46 fluid in the renal afferent veins of 0·000193 gm. The nitrogen strength of the urine is thus (other things equal) purely a function of the fluid pressure in the intertubular plexus, being inversely proportional. In another series of experiments (Appendix B) I ascertained that 0·025% of potassium ferrocyanide present in the renal afferent vein fluid alone did not appear in the urine, and that with ferrocyanide present in both arterial and renal afferent vein fluids, excess of strength of the latter up to three times that of the arterial fluid had no effect on the urine.[1] In a final experiment in which the following three fluids were employed :—

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[1] In Appendix B I have supplied some details of these and following experiments at length as examples of the methods adopted and results obtained.

[2] Ascertained by Gulick's method (Jour. Biol. Chemistry, Vol. 18, 1914, p, 541). Details of the method are also given in Plimmer's "Practical Organic and Bio Chemistry", 1915 p. 557. The late Dr. E G. Hill of Allahabad brought this method to my notice and assisted me in practical details.

Aortic fluid = Ringer's solution + 0·05% urea, 0·00625% ferro., 0·01% KI.
"46" ,, = ,, ,, + 0·0765% ,, , 0·00958% ,, , 0·0153 %KI.
"60" ,, = ,, ,, + 0·1% ,, , 0·0125% ,, , 0·02% KI.

the aortic fluid perfusing the renal arteries during the whole experiment, and the three fluids being successively perfused through the two renal afferent veins, the three samples of urine obtained were identical in composition.

I may mention that control experiments were performed in this as in all other series—the renal afferent vein fluids being perfused via the aorta instead of via the renal afferent veins—and in all these control experiments the urine composition corresponded in strength to the fluid perfused.

These results thus afford conclusive evidence that the arterial fluid in the intertubular plexus is the only one concerned with the secretion of urine and that with correct (i e. normal) flows, the venous fluid in the renal venous meshwork does not enter the intertubular plexus.

On the Results of a slight Increase of Pressure above the Normal in the Fluid in the Renal Afferent Veins.

The results of the experiments described in the last Section prove that, with correct relative flows and with the relative osmotic pressures of arterial and venous fluids specified. the fluid contained in the renal afferent veins (the venous supply) has nothing to do with the secretion of urine. The case is very different however if, in these experiments, the renal afferent vein perfusion bottles be raised from 1 cm.—3 cms. in height (according to the amount of deficiency of flow in the renal afferent veins below normal, relative to the arterial flow), thus increasing the flows of fluid in the renal afferent veins, both absolutely and relatively to the flow of fluid via the renal arteries. The flow of fluid in the renal afferent veins being above normal relative to the flow in the renal arteries, indigo-carmine dye injected into the veins at once appears in the urine, likewise potassium ferrocyanide and iodide and excess of nitrogen (as determined in over 20 experiments. See Appendix

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[1] Ferrocyanide estimated colorimetrically by addition of equal quantities of a stock solution of ferric chloride.

B for an actual illustration).[1] This result can alone be due to the excess of pressure in the renal afferent vein, and therefore renal venous meshwork, causing the venous fluid to penetrate to some extent into the intertubular plexus via the openings of the latter into the meshwork and so leading to *admixture of the venous fluid with the arterial.* This supposition, besides being the only possible one to account for the facts, is confirmed by the results of dye-injection experiments carried out with excess pressure in the renal afferent veins—the dye can be seen to have penetrated into the intertubular plexus under these conditions. Another result of excess of pressure in the renal venous meshwork fluid, which I may mention here, is that the arterial flow is retarded, and if the renal afferent vein pressure be raised to about 20 cms. the arterial flow is stopped altogether.

In the case of indigo-carmine injected into the renal afferent vein and appearing in the urine, the intensity of colour of the urine is, so far as I have ascertained, directly proportional to the amount of excess of fluid pressure in the vein, but the proportion is not a simple one—the urine increases in intensity of colour at a greater rate than the excess of pressure in the vein. This is possibly due to the dye behaving like common salt, the percentage of which in the urine is directly proportional to the fluid pressure in the intertubular plexus (vide Part III). The increase of dye in the urine may therefore be due both to admixture of the venous renal venous meshwork fluid with the arterial fluid and to the increase of pressure in the latter. In the case of excess of nitrogen being present in the renal afferent vein fluid and appearing in the urine, on the other hand, the results are different, the increase in nitrogen strength of the urine by no means being directly proportional to the amount of excess of fluid pressure in the vein. This difference of result is due to the fact that increase of fluid pressure in the intertubular plexus *diminishes* the percentage of nitrogen in the urine (vide Part III) and the percentage of nitrogen found in the urine in these experiments is the balance struck between the increased percentage due to admixture of the venous and arterial fluids and the diminished percentage due to the increase of pressure of the fluid in the intertubular plexus.

If it be argued that these facts do not constitute evidence for the venous fluid entering an intertubular plexus separate from the renal venous meshwork, because it may just as well be supposed that the excess of pressure in the renal afferent vein drives the venous fluid from the intertubular plexus (which, according to current opinion, is traversed by both the arterial and the venous blood or fluid) into the *glomeruli*, the reply is that this alternative supposition is impossible when the considerable difference of pressure which exists between the blood in the glomeruli and the blood in the intertubular plexus is taken into account. As I shall show in Part III, even the slight increase of blood pressure and flow produced in one renal afferent vein by the ligaturing of the companion renal afferent vein in a living frog is sufficient to increase the nitrogen-content of the urine secreted by the kidney retaining its venous supply, and in this case (and in many of my perfusion experiments) it is incredible that the blood in the intertubular plexus (usually said to be at about half the pressure in the glomeruli, i.e about 10 cms; in reality it is much lower than this) could ever penetrate into the glomeruli in which the blood pressure is usually said to be at least 20 cms., even if we assume that the increase of blood pressure above normal in the renal afferent vein amounted to as much as 2 cms. No physiologist has ever suggested that glomeruli can be injected with a pressure of 2 cms. above the normal (say 12 cms.) from the renal afferent veins *while the arterial circulation is in full force*, and indeed it requires at least 10 cms. pressure to effect this when the arteries are empty (4). The suggestion then that excess of nitrogen or dye or ferrocyanide can appear in the urine when the pressure in the renal afferent vein is raised 2 or 3 cms. above normal because the venous blood or fluid has been forced into the glomeruli cannot be entertained for the simple reason that it is physically impossible.

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[1] The same results are of course obtained if the arterial flow be reduced relatively to the venous flow. This was illustrated in several of my experiments in which, while the flows according to the bottle readings were apparently all that they should be, the urine secreted was distinctly blue—the explanation being that I had overlooked a leakage from the aorta or a cut branch of an iliac artery.

Apart however from the impossibility, examination of sections of kidneys perfused with indigo-carmine via the renal afferent vein in these experiments (the kidneys having been cut out after quick *simultaneous* ligature of all the vessels connected with the kidneys and immediately fixed in absolute alcohol) demonstrate conclusively that *in no case had the dye reached the glomeruli*. Thus in one experiment in which the renal afferent vein flow was to the aortic flow as 91 : 200 and the urine was a distinct blue, the kidney was found to be well injected with the dye, but this was restricted to the renal venous meshwork and intertublar plexus and *in no instance was dye to be observed in the glomeruli or capsules*. Dye granules were also to be seen in the tubule lumina and occasionally in the cells of the convoluted tubules. The same result was obtained in another experiment in which the relative flows were as 97 : 214 and the urine was deeper blue than in the preceding experiment. Here again *the glomeruli and capsules were quite devoid of dye*, though dye particles were to be seen in the convoluted tubule cells and of course in the tubule lumina, renal venous meshwork and intertubular plexus.

Similar results were obtained in another experiment in which the relative flows were as 112·259 and the urine was a distinct sky-blue, and in two others which I need not record.

These facts then prove, beyond possibility of doubt, (1) that the dye was secreted by the kidney tubules and not the glomeruli, and (2) that the intertubular plexus is normally solely traversed by arterial blood or fluid (as in the mammal kidney) and is structurally separate and distinct from the renal venous meshwork which is solely traversed by the venous blood at a pressure only a little lower than that in the intertubular plexus. The theory of kidney secretion which states that the urine is secreted by the tubules alone, the glomeruli taking no share save in the capacity of pressure-reducers and flow-retarders, I propose to call the Tubule cum Rete theory (to be discussed in Part IV) in order to distinguish it from the Bowman–Heidenhain theory which assumes that the glomerulus secretes most of the water of the urine.

Additional Evidence for the Structural Separateness of the Intertubular Plexus from the Renal Venous Meshwork derived from Perfusion Experiments under Abnormal Conditions of Osmotic Pressure.

In the experiments already alluded to in which I found that the urine secreted by a kidney with 30 fluid in its renal afferent vein was identical in amount and composition with the urine secreted by the companion kidney with 46 fluid in its renal afferent vein, I found it necessary, in order to ensure equal rates of flow through the two renal afferent veins, to add some additional salt (0·037%, e.g. added to the 0·6%) to the 30 fluid (which contained a smaller amount of added urine). the 46 fluid, like the arterial. consisting of 0·6% saline. In other words, I attempted to balance (the test of equality being equal rates of flow through the renal afferent veins) osmotically the greater proportion of urine in one fluid by a greater proportion of salt in the other. After completing these experiments, it naturally occurred to me to ascertain if I could balance osmotically the *whole* of the urine in the one fluid by a preponderance of salt in the other (which therefore contained no nitrogen), and, if so, what effect would be produced on the urine excreted. In most of these experiments I perfused 40 fluid (i.e. 0·6% saline plus 40 c c. fresh urine added to each 2000 c.c. of the saline) through the aorta, 61 fluid (61 c.c. of the urine being added instead of 40 c.c.) through one renal afferent vein and 0·7% saline through the other renal afferent vein. The results of these experiments (ten in number) were that (1) with correct flows, the kidney with 0·7% saline only in its renal afferent vein secreted urine weaker in nitrogen than the kidney with 61 fluid in its renal afferent vein, and that (2) the 0·7% saline in the renal afferent vein caused the flow of urine from that kidney to decrease and ultimately to stop,[1] the other kidney continuing to secrete freely.

Further experiments proved that the 0·7% saline solution in the renal afferent vein actively abstracted nitrogen from the arterial fluid in the intertubular plexus of that kidney, and thus led to the nitrogen-weaker urine.

The data of the preceding experiments provide another very powerful argument in favour of the separateness of the renal venous meshwork from the intertubular plexus. Thus, to take a typical experiment, the arterial fluid was of a nitrogen strength of 0·000180 gm. in 1 c.c., the fluid in one renal afferent vein was of a nitrogen strength of 0·000326 gm., and the fluid in the other renal afferent vein contained no nitrogen (pure 0·7% saline). The urine secreted by the kidney with the renal afferent vein fluid containing nitrogen was of a nitrogen strength of 0·000253 gm., and the urine secreted by the kidney with pure 0·7% saline in its renal afferent vein was of a nitrogen strength of 0·000180 gm., i.e. the relative nitrogen strengths of the two samples of urine were as $\frac{0\cdot000253}{0\cdot000180}$, and the average relative strengths in six experiments were as $\frac{0\cdot000193}{0\cdot000172}$. Now if we assume that the venous fluid mixes with the arterial fluid in the intertubular plexus, this means that three volumes of 0·7% saline are mixed with one volume of 0·6% saline plus 0·018% nitrogen, and this should result in the kidney supplied with pure saline via its renal afferent vein, secreting urine at least four times weaker in nitrogen than the urine secreted by the kidney which does not have its arterial fluid diluted (in nitrogen) in this way but, on the contrary (according to the hypothesis), strengthened by admixture with the nitrogen-stronger renal afferent vein fluid. Thus, assuming that the tubules secrete the urine, the comparative nitrogen strengths of these two samples of urine in these experiments afford one more definite proof of the entire separateness of the intertubular plexus from the renal venous meshwork.

I may add here, that just as, under these very abnormal conditions of osmotic pressure, nitrogen can pass from the intertubular plexus into the renal venous meshwork, so, under other very abnormal conditions, i.e. when pure saline (devoid of nitrogen) is perfused through the renal arteries and saline plus nitrogen is perfused through the renal afferent veins, nitrogen is found to pass from the renal venous meshwork into the intertubular plexus, and the urine contains nitrogen. In other words, under conditions approaching the normal, no diffusion of substances occurs between the two systems of sinusoids in the "portal" kidney intertubular plexus and renal venous meshwork but under very abnormal conditions, the severe osmotic tensions evoked by the abnormal conditions permit diffusion to occur.

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[1] Perfusion with saline alone, even through the renal arteries, gives in all cases a very scanty output of "urine." See e.g Experiment 1, Appendix H. Also see Experiment 4, Appendix C, in illustration of the statement in the text.

Another series of facts affords equally forcible evidence, both in favour of the separateness of the intertubular plexus and renal venous meshwork and of the view that it is the tubules which produce the urine and not the glomeruli. If saline plus nitrogen be perfused through the renal arteries, while the renal afferent vein is ligatured, secretion proceeds apace, but if pure saline be then perfused through the renal afferent vein with correct relative flow, the arterial flow is retarded and secretion at once becomes diminished. Apart from the abstraction of some nitrogen from the arterial fluid, I attribute this result mainly to the pure saline (a fluid of relatively low osmotic pressure) in the renal afferent vein causing constriction of the intertubular plexus capillaries. On the other hand, if a fluid of low osmotic pressure in the renal afferent vein be replaced by a fluid of high osmotic pressure, also at correct relative flow, the arterial flow is accelerated and urine secretion is markedly increased, *though the urine remains of the same composition*, and this result I attribute to the dilatation of the intertubular plexus capillaries. I have repeatedly obtained these results on many occasions with several kinds of perfusing fluids.[1] These facts are again in favour of the view that the intertubular plexus and renal venous meshwork are separate systems of vessels because, on the view that the tubules secrete the urine, the urine could not possibly remain unaltered in composition if the renal afferent vein and intertubular plexus fluids were mixed in a common system of vessels. On the other hand, the alternative view that the glomeruli filter off the urine from the blood is shown to be quite untenable by these same facts. Quite apart from the physical impossibility, with correct flows, of the renal afferent vein fluid of high osmotic pressure being able to penetrate to the glomeruli[2] (and even if it were able to initially, the resulting increased rate of flow of the arterial fluid through the glomeruli would soon stop the penetration), it is evident that if, as I maintain, the high osmotic pressure of the renal afferent vein fluid dilates the capillaries of the intertubular plexus, then, on account of the resistance of the intertubular plexus becoming reduced, the pressure in the glomerular capillaries must also become reduced, and this will, on the hypothesis, result in a diminution of the volume of glomerular filtrate and not an increase. The filling of the intertubular plexus also leads to increased absorption by the tubules—another factor which should reduce the volume of urine On the other hand, if a fluid of low osmotic pressure in the renal afferent vein constricts the intertubular plexus capillaries, this will raise the fluid pressure in the glomerulus and should, on this account, increase the volume of glomerular filtrate, but, as we know, the contrary is the case.

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[1] In view of the theoretical importance of these facts (Part IV) I have provided the details of a few of these experiments in Appendix C.

[2] Even if we assume that it can do so and that it produces an increased glomerular filtrate, this filtrate will be different in composition from the filtrate previously produced: but in my experiments, with correct flows, *the composition of the increased volume of urine remained unaltered, whatever substance was employed in the renal afferent vein fluid*

The only possible conclusions from the facts are that increased osmotic pressure of the renal afferent vein fluid causes dilatation of the intertubular plexus capillaries and so increases the volume and rate of flow of the fluid in it—with a resulting increase of urine of the same composition as that obtained with renal afferent vein fluids of lower osmotic preasure: that lowered osmotic pressure of the renal afferent vein fluid produces the opposite effect by constriction of the intertubular plexus capillaries; that the intertubular plexus is physiologically and structurally separate from the renal venous meshwork, and that the tubules secrete the whole of the urine, the glomeruli taking no direct part.

Conclusions and Brief Review.

I have, in the preceding abstract, stated five a priori reasons, all of considerable weight, for regarding the "renal portal" system (renal venous meshwork) as devoid of any function. If these reasons be accepted as valid, it is practically certain that the renal venous meshwork (which after all is only a broken-up portion of a purely extraneous structure—an adjacent vein returning blood from the hind limb and pelvic region) can have no physiological connection with, much less form part of, the intertubular plexus of the Amphibian or other "portal" type of kidney. This conclusion is also in accordance with such well-known facts and considerations as that (a) the kidney is in the whole Vertebrate series constructed on

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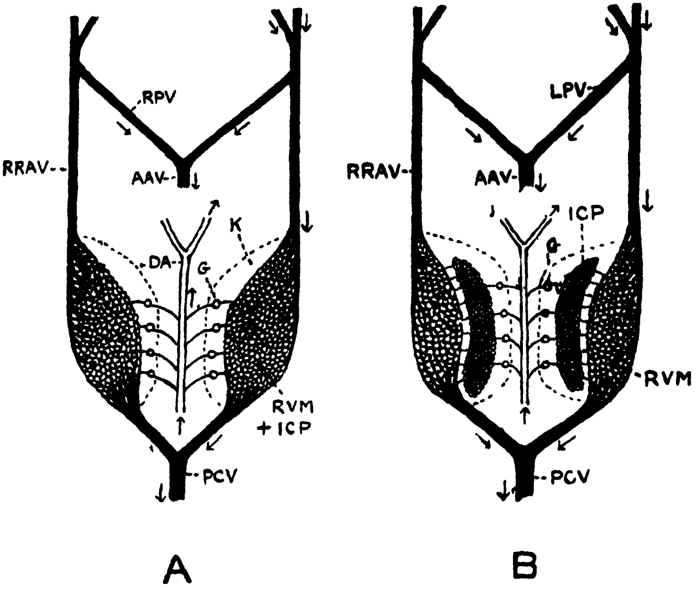
to raise its osmotic pressure. If it be argued that the high osmotic pressure of the renal afferent vein fluid dilates the glomerular capillaries in the same way as I suppose that it dilates the capillaries of the intertubular plexus, the reply is that such dilation will reduce the fluid pressure in the glomerulus and should therefore, on the hypothesis, diminish the glomerular filtrate: it certainly cannot increase it.

a uniform plan, viz. a system of tubules each supplied with branches from the efferent glomerular artery, and this plan would hardly undergo such a fundamental physiological modification in certain groups as the filling of the tubular capillaries with a volume of venous blood three times the amount of the arterial: (b) purely venous blood invading the intertubular plexus as a consequence of the cutting-off of the arterial blood flow and of raised osmotic pressure due to diuretics (as in Schmidt's and Beddard's experiments—vide 36, 8) is deleterious to the tubule epithelium, causing the cells to degenerate, and though the venous blood[1] is supposed to be diluted with



CURRENT THEORY ACTUAL CONSTRUCTION

TEXT-FIGURE 2. Diagrams illustrating the current theory (A) and the actual construction (B) of the Amphibian kidney. In B the intertubular capillary plexus (ICP) is shown to be structurally distinct and separate from the renal venous meshwork (RVM), and the former is supposed to have been disentangled from the latter and pulled apart. The renal venous meshwork is to be regarded as merely a portion of an originally wide non-fenestrated vein into which the efferent capillaries of the intertubular plexus would naturally open. AAV, anterior abdominal vein; DA, dorsal aorta; ICP, inter-tubular capillary plexus; G, glomerulus; LPV, left pelvic vein; PCV, post-caval vein; RRAV, right renal afferent vein; RVM, renal venous meshwork.

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[1] As I have already pointed out, Cushny (7) colors the blood in the "renal portal" vein of his figure 14 a bright scarlet and purple in his

one quarter of its volume of arterial blood[1] in normal animals, yet it is very doubtful if active glandular cells would, under these circumstances, obtain sufficient oxygen, since we know that the oxygen consumption per gram of kidney tissue is certainly not less than in other organs; and (c) "when the same kidney is perfused at different times through the aorta, and through the renal portal system, there is a greater consumption of oxygen in the former case than in the latter (double to treble in four experiments)"[2] (10), a fact which it is impossible to explain on any other theory than that the "renal portal" system does not come into physiological contact with the tubules, since the Bowman capsules (supposed to be mere filters) cannot be supposed to absorb oxygen to any appreciable extent.

As we have seen, the evidence advanced by physiologists in favour of the view that the renal venous meshwork and the intertubular plexus proper form one common system of sinusoids supplying the tubules, is invalidated by the lack of precautions to secure correct relative rates of flow of the perfusing fluids via the renal arteries and the renal afferent veins: in all previous experiments known to me the renal afferent vein perfusion pressure has probably been excessive. In the normal frog the flow of blood along each renal afferent vein probably never exceeds one-third of the flow along the aorta, and it is most essential in double dye-injection and other perfusion experiments that these relative rates of flow should be reproduced, since if, as I contend, the intertubular plexus and the renal venous meshwork constitute two separate systems of channels (the former only opening into the latter at points where the blood is near the efferent renal veins). any departures from the normal relative rates of flow will cause either the arterial or the venous fluids to penetrate into channels which the blood they represent in the living animal never enters. I have referred to numerous perfusion experiments conducted by me, the results of which prove that under normal conditions the fluid in the renal venous meshwork has no influence on kidney excretion. The facts to be described in Parts II and III will demonstrate that, in the living animal also. the venous blood in the renal venous meshwork, under normal conditions, does not affect the kidney secretion. Under

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figure 15. I need hardly say that there is no justification for either of these colors. The blood in the renal afferent veins is as blue as that in the post-caval.

[1] It may also be recalled to mind that, owing to the heart of the frog only possessing a single ventricle, the blood in the aorta is not purely arterial as in higher Vertebrates but is already mixed to some extent with venous blood.

[2] The small amount of oxygen which is absorbed on perfusion via the "renal portal" system is probably due to the fluid penetrating into part of the empty intertubular capillary plexus.

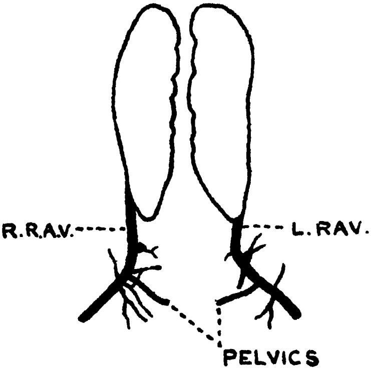
abnormal conditions however, whether of excessive flow in the renal afferent vein or of difference of osmotic pressure of the fluids present in the renal venous meshwork and intertubular plexus, the fluid in the renal afferent vein can and does influence the arterial fluid in the intertubular plexus, the amount and composition of the urine varying in consequence, but these abnormal conditions of course never occur in nature. The value of these experiments under abnormal conditions however is that they afford additional proof of the two propositions which it is the object of this memoir to substantiate, viz. the non-functional character of the so-called "renal portal" system (and therefore the separateness of the renal venous meshwork from the intertubular plexus) and the secretion of the whole of the urine by the urinary tubules, the glomeruli taking no direct part (a subject which I shall discuss more fully in Part IV).

I should like here to express my indebtedness to the late Professor E. G. Hill, D.Sc., Principal of the Muir Central College, Allahabad, for his very kind assistance in connection with chemical work. Though in failing health at the time he aided me in every way, and but for him and for Dr. A. P. Sircar, I should have been severely handicapped in my enquiries. I also wish to offer my sincere thanks to Sir Arthur Keith, F.R.S., for very kindly sending me a full abstract of the paper by Gurwitsch (discussed in Part III) and for aiding me in other ways, and to Professor W. M. Bayliss, F.R.S., for the large amount of time he has generously devoted to reading through the manuscript and supplying advice and criticism. I also wish to thank Professor E. H. Starling, F.R.S., and Professor J. P. Hill, F.R.S., for similar assistance kindly given. Professor R. Moody, M.A., has also kindly aided me in connection with certain calculations. Finally, I wish to express my great indebtedness to Dr. S. W. Kemp for his assistance in the publication of this memoir.

PART II.

KIDNEY SECRETION WITH AND WITHOUT THE RENAL AFFERENT VEIN SUPPLY IN LIVING TOADS AND FROGS, AND IN PERFUSION EXPERIMENTS.

In Part I, I have adduced sufficient evidence (though stated in a very abridged form) to prove (1) that the "capillarization" of the renal afferent vein (the renal venous meshwork) in the substance of the "portal" kidney is distinct and separate from the true capillarization of the efferent glomerular arteries round the tubules—the intertubular plexus—, save where the latter enters the distal portions of the former for the exit of the arterial blood; and (2) that the venous blood takes no part in urine secretion under normal conditions. It is obviously important to check the second conclusion by experiments on the living animal, and during the years 1915–18 inclusive, I carried out a large number of experiments which consisted of ligaturing both or one only of the two renal afferent-veins in specimens of an Indian toad—*Bufo stomaticus* (Lütken)[1] —common in the United Provinces (India) and of observing the effects (especially on the composition of the urine when compared with that of the urine of normal control toads) produced in those animals which survived the operation. I may add that I selected toads in preference to frogs for these experiments because the former can be kept under relatively dry conditions (an occasional moistening of the belly skin being alone necessary) and hence sepsis of the wounds is far less liable to occur.



3.

TEXT-FIGURE 3 (× 2). The regenerated renal afferent veins of the Toad J, from the ventral aspect. RRAV, right renal afferent vein; LRAV, left renal afferent vein. The regenerated veins differed from normal renal afferent veins in being plastered, so to speak, against the dorsal peritoneum—they did not stretch across the body-cavity like normal veins.

The Ligature of Both Renal Afferent Veins in Bufo stomaticus.

In nine toads, which I will designate A, B, C, D, E, F, G, H, and J, I ligatured (from the dorsal surface) both renal afferent veins[2] (each vein being ligatured in two places and cut between the ligatures), and the toads survived for the following periods .—

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[1] Dr. N. Annandale informs me that this is the correct naming of the *B. Andersonii* of the " Fauna of British India."

[2] I did not ligature the dorso-lumbar veins—an omission of no consequence in view of their small size. The renal afferent veins were exposed

Toad A died after six weeks.

Toad B was *killed* after eight weeks (thin but healthy inside and out).

Toad C was *killed* after twelve weeks (healthy save for cysts present in the liver and mesentery).

Toads D and E died after three weeks and three days.

Toad F died after five weeks and four days.

Toad G died after five weeks and six days

Toad H died after twelve weeks and four days

Toad J was *killed* after one year, nine weeks and two days (perfectly healthy inside and out).

In all the toads which died and in Toads B and C no signs of regeneration of the cut renal afferent veins were apparent at the post-mortem, but in the Toad J, I found that both renal afferent veins had been completely regenerated (text-figure 3). The significance of this fact I shall refer to later.

In all the toads except J, the kidneys had become appreciably enlarged (i.e. the ratio $\frac{\text{Total weight of body at time of operation}}{\text{Total weight of the two kidneys at time of death}}$ was greater in these experimental toads than the corresponding average ratio determined in 56 normal toads).[1] This subject also will be discussed later. The liver did not increase in size, though it obviously received more blood than usual.

The total nitrogen output in the entire amount of urine of the Toad F (body-weight at time of experiment = 29·7 gms) excreted during five consecutive days was 0·05047 gm..[2] while those of two normal control toads (weighing 24·5 gms. and 34 7 gms.) during the same period and under precisely the same conditions were 0·04125 gm. and 0·05790 gm respectively. Thus, relative to the weight of the body, the amount of nitrogen excreted by the Toad F during this period was certainly not less than the corresponding amounts of nitrogen excreted by the two control toads. The similar total nitrogen output of the Toads G and H (placed together in one jar : G weighed at

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by lifting out the hind ends of the kidneys through slits made in the dorsal muscles.

[1] The average kidney ratio of the 56 normal toads was 233·9, the lowest ratio being 143·7 and the maximum 335·7. In Toads A, B, C, D, E, F, G, H, the ratios were respectively 165·7 (and probably smaller owing to a large coelomic effusion being included in the body-weight), 137·6, 149·6, 127·0, 159·3 (a coelomic effusion included in the body-weight). 112·9, 120·3, 89·9.

[2] The whole of the urine excreted during the five days was carefully collected and separated from faecal matter by filtration. Total nitrogen determinations by Gulick's method.

the time of the experiment 17·0 gms. and H 22·5 gms.) during six days was 0·01879 gm.,[1] while that of one pair of control toads (body-weights at time of experiment = 17·0 gms. and 20·2 gms.) during the same period was 0·01100 gm., and that of another pair of control toads (body-weights at time of experiment = 17·2 gms. and 16·2 gms.) during the same period was 0·01822 gm. Thus, again, the kidneys of the Toads G and H (deprived of a venous supply) each excreted as much nitrogen in a given time as each of the kidneys (retaining their venous supply) of four control toads.

During one month I estimated the nitrogen strengths of four samples of urine[2] (volume of an average sample = 0·35 c.c) obtained from the Toad G, which were 0·00046 gm. in 1 c c., 0·00093, 0 00506 and 0·00220, the average nitrogen strength of which is 0·00216 gm in 1 c.c. The corresponding nitrogen strengths of eight samples of urine (volume of an average sample = 0·55 c c) obtained during the same period from the Toad H were 0·00106 gm., 0·00180, 0·00100, 0·00276. 0·00071 0·00114, 0·00256 and 0·00393. the average nitrogen strength of which is 0·00187 gm in 1 c.c. And from the Toad J (about three weeks after the operation and therefore long before the two renal afferent veins could have been regenerated) the nitrogen strengths of five samples of urine (volume of an average sample = 0·68 c.c.) during the same period were 0·00094. gm., 0·00075. 0·00128, 0·00053 and 0·00106, the average nitrogen strength of which is 0·00091 gm. in 1 c.c In one normal control toad the nitrogen strengths of five samples of urine (volume of an average sample = 0 95 c.c.) obtained during the same period were 0·00096 gm., 0·00156, 0·00084, 0 00088 and 0 00172, the average nitrogen strength of which is 0·00119 gm. in 1 c.c., and the nitrogen strengths of single samples of urine (average volume of which = 0·47 c.c.) obtained from nine other control toads (kept under precisely the same conditions) were 0·00130 gm , 0·00120, 0·00072, 0·00012, 0·00068. 0·00100, 0·00026, 0·00030 and 0·00080, the average nitrogen strength of which is 0·00071 gm. in 1 c.c. From these data it can be seen that the samples of urine of the Toads G, H and J (with kidneys deprived of a venous supply) were neither less in volume nor deficient in nitrogen strength when compared with samples of urine obtained from control toads (with kidneys retaining their venous supply). These facts once more prove that the venous supply of the "portal" kidneys is of no consequence in connection with urine secretion.

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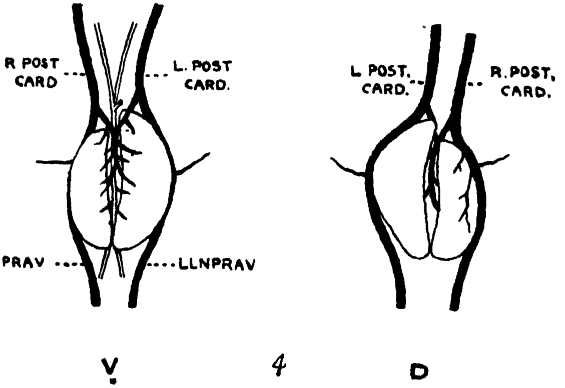
[1] It will be noticed that this quantity is considerably less than the quantity excreted by the single toad F in five days. The difference is due to the fact that the Toad F and its controls were fed on house-flies (a highly nitrogenous diet), while the Toads G and H and their controls were fed on crickets.

[2] Samples of urine from toads and frogs can easily be obtained by holding the animal over a funnel and rubbing the belly with a dilute acid, when urine is almost immediately squirted, the bladder being entirely emptied. With ordinary toads and frogs I employ dilute sulphuric but this injures the skin in time: with experimental toads I use lemon juice, which however is not quite so effective.

From the Toads A, B, C, F, H and J, I carefully removed the renal arteries and compared them (average diameter) with the arteries of twelve of the normal control toads. The conclusion I arrived at from these few data was that the renal arteries of the toads deprived of a venous supply to the kidneys are not so large, relatively to the body-weight, as the arteries of many normal toads, but are perhaps slightly larger than those of the average normal toad. I arrived at a similar conclusion from the measurement of the renal arteries of an abnormal specimen of *Rana temporaria* (which I labelled OD,[1] text-figure 4), both kidneys of which were naturally devoid of a venous supply owing to both renal afferent veins (persistent posterior cardinals) maintaining a direct connection with the two pre-caval veins,



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TEXT-FIGURE 4 (× 2). The two persistent posterior cardinal veins in the male *Rana temporaria* labelled OD. V, ventral aspect; D, dorsal aspect. RLNPRAV, right large non-portal renal afferent vein; LLNPRAV, left ditto. The small size of the right kidney is noticeable. External diameter of the left "renal afferent" vein (posterior to the kidney) was 0·883 mm. and of the portion anterior to the kidney 1·033 mm. The external diameter of the right "renal afferent" vein was 0·930 mm. and anteriorly to the kidney 1·085 mm. The external diameter of the anterior abdominal vein was 0·775 mm. The left kidney (with the smaller "renal afferent" vein) weighed 0·072 gm., and the right kidney 0·039 gm.—a difference of 0·033 gm.! The kidney ratio (body-weight = 16·180 gms.) was 149·8, whereas the kidney ratios of six normal male *R. temporaria* were 147·7, 121·9, 137·4, 138·5, 125·4 and 163·3—the kidneys therefore were not larger than usual.

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[1] I am indebted for this rare specimen to the kindness of Dr. C. H. O'Donoghue who sent it to me.

and comparison with the arteries of six normal control *R. temporaria* of the same size and sex. If hypertrophy of the renal arteries of the experimental toads has occurred, it is evident that it is so small as to be devoid of any significance if regarded as a compensation for the elimination of the venous supply. This will be the more easily realized when we remember that the venous supply (as I have determined in the frog *Rana tigrina* (see Appendix A, Part I) to the kidneys is about three times the volume of the arterial supply, from which it may be deduced that if this venous blood is of use to the kidneys in producing secretion it would need a very considerable amount of hypertrophy of the arteries to compensate for its loss.

The Cause of the Death of the Majority of the Experimental Toads and the Regeneration of the Renal Afferent Veins in the Toad J.

Ligature of both renal afferent veins in the living toad (or frog) necessarily involves considerable perturbations in the blood supply of the body. In the first place, since the anterior abdominal vein has to convey to the heart *all* the blood returned from the legs and pelvic region: (1) the liver receives nearly $\frac{5}{3}$ times [1] as much blood as is normally the case—a quantity which, though vastly in excess of the normal, is yet less than the entire quantity of blood normally transmitted to the heart by both renal afferent veins and the anterior abdominal, owing to the relatively increased resistances offered to the flow of the increased volume of blood by the distended walls of the anterior abdominal vein and of the capillaries of the liver. Again, the rate of outflow of blood from the legs being therefore decreased, and the iliac arteries still forcing blood in, though in diminished quantity owing to the additional resistance offered. (2) the veins of the hind legs will, with the anterior abdominal, become greatly distended with blood (forming reservoirs), and therefore there is so much the less for the heart to receive and therefore to pump out—the result being a considerable deficit of blood in the whole of the arterial system and therefore a paucity of supply to the body in general; (3) the hind legs will receive even less fresh blood than other organs owing to the increased resistance offered by their already partially-blocked venous system; and (4) the arterial supply to the kidneys will be diminished, as to all other organs, but the kidneys will suffer more than other organs because not only are they posteriorly situated (i.e. in a region of low blood pressure in the aorta), but in order to function well, they, as is well known, depend more than other organs on a large blood supply.

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[1] This estimate is founded on the relative areas in transverse section (calculated from the external diameters) of the renal afferent veins compared with the anterior abdominal (see Appendix D).

During the first week or fortnight, while the toad is recovering from the effects of the operation, the urine is generally more dilute than normal urine, but at the end of this period, when the wound has almost or quite healed and the animal is as lively as the control normal toads, the urine excreted is, as we have seen, as plentiful and as strong in contents (nitrogen) as that of the normal toads. We must therefore conclude that during this convalescent period the body has produced an additional quantity of blood sufficient to make up for the quantity lying useless in the enlarged anterior abdominal and leg veins, and the organs in general will then receive as much blood as formerly. But there are two exceptions to this statement, viz. the liver which, until the re-formation of the ligatured renal afferent veins, will receive more than its normal quantity of blood, and the legs which, for the reason already given, will continue to receive less. The toads (not enumerated) which died in less than two or three weeks subsequent to the operation probably died from the effects of the operation; Toad J, on the other hand, not only survived the operation but also the physiological disturbances which must ensue in connection with the liver and legs due respectively, as already stated, to too large a supply of venous blood and too small a supply of arterial blood. These disturbances are evidently quite sufficient by themselves to account for the re-formation of the two renal afferent veins, without assuming that the renal afferent supply of venous blood to the kidneys is in itself essential to the health of the toad. The facts already recorded that toads can live three months in an apparently healthy condition without a "renal portal" system is sufficient to prove this, and it is therefore practically certain that if we could perform the operation of making the two renal afferent veins open directly into the post-caval or other large vein, thus eliminating the "renal portal" system and at the same time avoiding excess of blood supply to the liver and deficient blood supply to the legs,[1] the toads would after the operation resemble normal toads in every respect and the renal afferent veins would not re-form so as to re-establish connection with the kidneys. Additional proof of this is afforded by the discovery in a male specimen of *Rana temporaria* (the frog OD. the renal arteries of which I have already referred to—text-figure 4) of practically the condition of things which would exist if the supposed operation I have just described were possible in practice.

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[1] In all those abnormal frogs which have been described in which one of the kidneys is deprived by nature of a "renal portal" supply, the renal afferent vein opens either directly into the post-caval or into a pre-caval via a persistent posterior cardinal, thus *in every case* avoiding an excess of blood supply to the liver.

Toad B and possibly Toad C might have emulated Toad J in surviving long enough to allow of the regeneration of the two renal afferent veins had they not been chloroformed. Toads D, E, F and H apparently died from the effects of the excess of venous blood supply to the liver (liver unhealthy and containing many cysts full of granular matter, swollen gall bladder and coelomic effusion) and the deficient arterial blood supply to the legs (discoloration and sores on skin of legs due to gangrene), and possibly in some cases ineffective sterilization of the wound (Toad G ?). I have already provided evidence to show that the ligature of the two renal afferent veins--the elimination of the " renal portal " system—was not *per se* the cause of death or even disease in these toads; the kidneys can function quite efficiently when deprived of their venous blood supply.

On the Increase in Size of the Kidneys in Toads with Ligatured Renal Afferent Veins. The Ligature of one Renal Afferent Vein in Living Toads.

It may be argued that the enlargement of the kidneys in toads with ligatured renal afferent veins is an indication that the venous "portal" supply was of use to the animal, the kidney enlargement being in compensation for its loss. But hypertrophy of an organ is nearly always, if not always, associated with an increased blood supply, and this is certainly not the case in this instance, since not only is the whole of the (supposed useful) venous supply cut off, but, as we have seen, the renal arteries do not become enlarged. Moreover, that this kidney hypertrophy is of no significance in connection with the problem of the " renal portal " system is clearly shown by the fact that in the abnormal specimen of *Rana temporaria*, referred to above as having been devoid of a " renal portal " system from birth (the frog OD), the kidneys were slightly below the average in size (when compared with the kidneys of six normal *R. temporaria*). In this connection it is further interesting to note that when *one* renal afferent vein is ligatured in a living toad, one kidney therefore being non-portal and the other " portal, " the non-portal kidney does not increase in size compared with the " portal " kidney, though both may perhaps enlarge equally to a very small extent. In 1915, I ligatured the right renal afferent vein in four toads. One died after three weeks and three days, one after seven weeks and six days, and the other two I *killed* after seven weeks, six days (perfectly healthy, inside and out) and eleven weeks, six days (healthy save for a few cysts in the liver) respectively. In the first toad the two kidneys were exactly equal in weight (each = 0·060 gm.); in the second, the left " portal " kidney weighed 0 352 gm. and the right non-portal 0·315 gm.; in the third, the left "portal" kidney weighed 0·126 gm. and the right non-portal 0·133 gm.; in the fourth, the left "portal" kidney weighed 0·123 gm. and the right non-portal 0·101 gm. In these four experimental toads therefore not a single non-portal kidney shows appreciable increase in size compared with the "portal," and only in one case (the second) is there any marked difference of weight between the two kidneys, and this is in the reverse direction, the "portal" being the larger. O'Donoghue (31), on the other hand, maintains that in the few known examples of abnormal frogs (*R. temporaria*) in which the kidney of one side is naturally deprived of a venous supply, the "portal" kidney is always the larger, and he considers this as evidence of the functional importance of the "renal portal" system. [1] Before describing these few examples I may remark that one conspicuous difference between these natural examples of one-side-"portal"-one-side-non-portal frogs and my experimental toads is that in the former the abnormal "renal afferent" vein, instead of being ligatured (and thereby increasing the quantity of venous blood in the anterior abdominal and the other renal afferent vein), is merely continued either into a persistent posterior cardinal vein on the same side of the body or directly into the post-caval vein, *thereby not increasing the quantity of venous blood in the normal renal afferent vein or anterior abdominal.* To be brief, I may say that O'Donoghue's contention is an impossible one to maintain, as he himself would doubtless admit had he studied the facts more in detail. In one of the abnormal frogs figured by O'Donoghue (his figure 1), the normal left "portal" kidney weighed 0·105 gm. and the abnormal non-portal right kidney weighed 0·088 gm.—a difference of 0·017 gm.; and in another frog figured by O'Donoghue (his figures 2 and 4), the normal right 'portal" kidney weighed 0·031 gm. and the abnormal left non-portal kidney weighed 0·026 gm.—a negligible difference of 0·005 gm. In a more recent specimen labelled CH kindly sent to me by Dr O'Donoghue (text-figure 5), the right normal "portal" kidney weighed 0·104 gm. and the left abnormal non-portal kidney weighed 0·099 gm.—again a negligible difference of 0·005 gm. To ascertain if these differences occurred in normal *R. temporaria* I weighed the kidneys of sixteen *R. temporaria* taken at random and found that in one the difference of kidney weight was 0·018 gm., that in nine others the difference in kidney weights varied between 0·005 gm. and 0·009 gm. and that in the remaining six the differences were less than 0·005 gm. These data proved that the slight differ-

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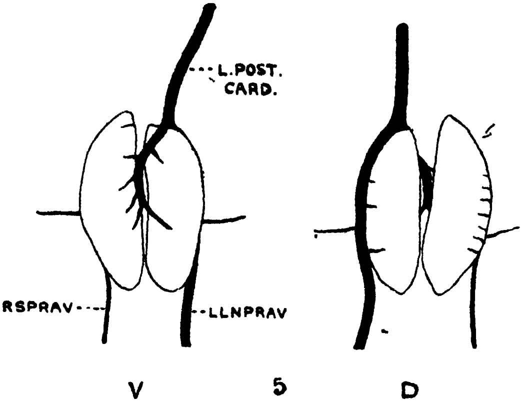
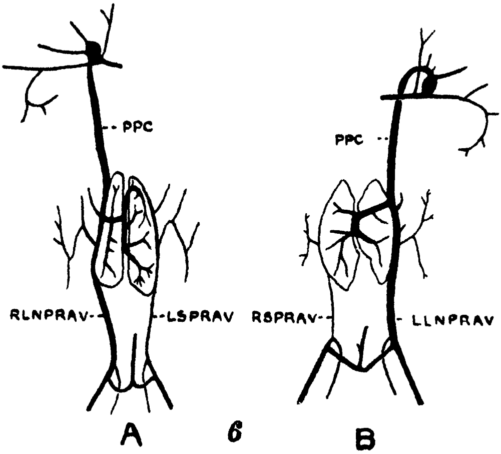
[1] In all these frog abnormalities which I have seen or read about (vide 37, 15, 43, e.g.) the normal renal afferent vein is very small in comparison with the renal afferent vein which opens directly into the post-caval or persistent posterior cardinal, hence in these abnormalities the normal "portal" kidney receives much less venous blood than usual—a fact in itself of considerable significance (see text-figure 6).





Text-figure 5 (× 2). The persistent left posterior cardinal vein in the frog, (*R. temporaria*,) labelled CH. V, ventral aspect; D, dorsal aspect. RSPRAV, right small "portal" renal afferent vein; LLNPRAV, left large non-portal renal afferent vein. The right "portal" renal afferent vein only measured 0·341 mm. in external diameter, while the left non-portal renal afferent vein measured 0·852 mm. The external diameter of the anterior abdominal vein measured 0·930 mm. and was therefore small.

Text-figure 6. A. Persistent right posterior cardinal vein in a frog (after Woodland, 43).

B. Persistent left posterior cardinal vein in a frog (after O'Donoghue, 33).

The difference of calibre of the "portal" and non-portal renal afferent veins is conspicuous. PPC, posterior cardinal vein: RLNPRAV, right large non-portal renal afferent vein; LSPRAV, left small "portal" renal afferent vein; RSPRAV, right small portal renal afferent vein; LLNPRAV, left large non-portal renal afferent vein.

ences of kidney weight found in the three abnormal frogs are of no significance.[1]

The Comparison of Samples of Urine excreted by Frogs (Rana tigrina) *with Both Renal Afferent Veins Ligatured, and by Frogs with these two Veins Unligatured.*

Since we have seen that ligature of the two renal afferent veins temporarily causes a diminished blood supply to the kidneys via the renal arteries, it is useless to compare the urine output of frogs with the veins ligatured with that of frogs retaining their renal afferent veins, since the former must, under the conditions, necessarily be less during the 24 hours over which the experiment extends (for the method of experiment see Part III) The nitrogen strength of the urine of the frogs with ligatured veins will also probably be less because of the restricted circulation through the legs (which together outweigh the rest of the body). In the toads with both renal afferent veins ligatured, on the other hand, both of these deficiencies must, as we have seen, have become remedied during the several weeks over which the experiments extended (probably by the genesis of additional blood and by enlargement of the leg veins), but in the decerebrate frogs of these experiments this is impossible. I confirmed these conclusions when I compared the urine output of six frogs with ligatured renal afferent veins with the output of urine of five frogs with intact renal afferent veins (the two series of frogs being treated exactly alike in all other respects) and found that *on the average* the urine of the former was both less in amount and weaker in nitrogen compared with that of the latter, though *individual* frogs with ligatured renal afferent veins may excrete more and nitrogen-stronger urine than individuals with the veins intact.

Perfusion Experiments on Frogs' Kidneys respectively with and without the Renal Afferent Vein Supply.

I now proceed to state briefly the results of a number of perfusion experiments which, since they concern the kidneys alone and are unaffected by changes in other parts of the body afford more reliable data than preceding experiments. In these experiments (ten in number described in detail in Appendix E) the amounts and nitrogen and chloride (as NaCl) strengths of samples of urine are compared when these samples were excreted respectively by kidneys (1) possessing their venous supply, and (2) deprived of their venous supply. The method adopted in connection with these experiments was to perfuse 0·6% saline plus 40 c.c. fresh human urine added to each 2,000 c c. of the saline through the aorta and 0 6% saline plus 61 c.c. of the same stock of human urine added as before to each 2,000 c.c. through each of the two renal afferent veins at correct relative flows. In one part of each experiment urine was collected while the renal afferent vein perfusion was in force ; in the other part of each experiment urine was collected while the renal afferent vein perfusion was stopped. These two samples of urine were compared as to quantity, and nitrogen and chloride strengths, due account being taken as to whether the experiment was commenced with the renal afferent veins open or closed.

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[1] A conclusion amply confirmed by the kidneys of the frog OD, in which, though the two kidneys possess similar blood supplies, the difference of kidney weight was 0·033 gm. See text-figure 4

The results I obtained, after the most careful elimination of all factors which might defeat a true comparison, were that (1) the amounts of urine secreted during the two conditions (renal afferent veins open and renal afferent veins closed) were on the average equal ; (2) the nitrogen strengths of the urine samples were the same under the two conditions ; and (3) the chloride (as NaCl) strengths of the urine samples under the two conditions were also identical. This last result contradicts the statement of Bainbridge, Collins and Menzies (4) that "a simultaneous arterial and venous perfusion, however, seems to be more conducive to the formation of a *very dilute*[1] urine than is arterial perfusion alone." Since, however, the quantities of urine examined (by the refractometer) by these authors were rarely more than 0·1 c.c., while my quantities were rarely less than 1·0 c c. and were estimated for chloride (Mohr method) by an independent professional chemist (Dr. A P Sircar), and since these authors give few or no details respecting the conduct of their experiments, especially from the point of view of the relative flows in the aorta and renal afferent veins—in other words, the shutting-off of the renal afferent vein perfusion may have, by restricting the outflow from the aorta, raised the pressure of the aortic fluid and so have increased the chloride content of the urine, the urine chloride content varying directly with the pressure of the arterial fluid or blood (see Appendix G, Part III)—I am of opinion that my results are by far the more reliable (see Part III for additional confirmation). Many of the conclusions of Bainbridge, Collins and Menzies (4), as of other authors, are vitiated by the idea that the renal afferent veins supply the kidney tubules, and I demur entirely, e.g. to such assumptions as that when the aorta is perfused with boiled Ringer's solution only the glomeruli are affected, and that the tubules can be killed (except at great venous pressure) when the renal afferent veins are perfused with 1/10,000 mercuric chloride.

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[1] My italics. The term "dilute" here refers to sodium chloride, the chief solid constituent. These authors also state that "the urine obtained on a simultaneous arterial and venous perfusion does not, so far as we could determine, differ in amount from that obtained on an arterial perfusion alone," and Miss Cullis (16) comes to the same conclusion.

The facts supplied in the present Part II are then corroborative of the conclusions reached in Part I. For the most part they merely confirm, in the living animal, what has already been demonstrated by, or might be inferred from, the results of perfusion experiments. This confirmation however is, quite apart from the value of the new facts described, of considerable importance in view of the slur so often and undeservedly cast upon the results of perfusion experiments on the kidney. In Part III further confirmation by experiments on the living animal of the results obtained from the perfusion experiments of Part I will be supplied.

PART III.

REPETITION AND EXTENSION OF THE EXPERIMENTS OF GURWITSCH AND INTERPRETATION OF THE RESULTS. THEORETICAL CONSIDERATIONS.

Previous Experiments.

The experiments of Gurwitsch (20) constitute, so far as I am aware, the only previous attempt to compare in the frog the quantities of urine obtained respectively from a kidney with the renal afferent vein ligatured and from the companion normal kidney, i. e. with the renal afferent vein intact. Gurwitsch wisely exposed the kidneys of the frogs he experimented on from the dorsal aspect and ligatured on one side the " reno-portal " vein and its confluent the dorso-lumbar (and in the female the small oviducal veins were cauterized with a red-hot needle), leaving these veins on the other side intact. Urine or urea solution was injected into the intestine at the time of operation as a diuretic Gurwitsch only gives the quantitative results of two of his experiments, viz. that (1) the total secretion of urine is very small in quantity, and (2) that the ligatured kidney secreted less than the normal kidney (the ligatured kidney secreted 0·5 c.c. and the normal or unligatured kidney 0·8-1·0 c.c. in two hours), and, so far as I am aware, says nothing concerning the qualities of the samples of urine so obtained.

Deferring until later consideration of Gurwitsch's statements of results obtained by him on injecting dyes into the frog's circulation under the above conditions, I will proceed to state the results of my own experiments on the quantity and quality of urine derived respectively from kidneys with ligatured renal afferent veins and from normal control kidneys with veins intact, in specimens of the common Indian frog, *Rana tigrina*—a very large species (some specimens weighing over twelve ounces—over 340 gms.—i.e. some ten times the weight of the average *R. temporaria*).

I may add here that in all my experiments the cerebrum, optic lobes and cerebellum were removed, the medulla being carefully preserved intact in order to ensure the continuance of respiratory movements, which of course are absolutely essential to the success of the experiments. These respiratory movements commonly continued for twelve hours and sometimes for more than twenty-four hours. The operation was of course performed from the dorsal side.[1] In all experiments water was placed in the dish to enable the belly-skin to absorb what it required, and whenever possible I endeavoured to collect samples of urine of at least 1 c.c.

Repetition of Gurwitsch's Experiments.

Only in four (out of fourteen attempted) experiments was I able to obtain sufficient quantities of urine for total nitrogen estimation. The results were not satisfactory, being contradictory for the most part, the only certain result being that the urine of the kidney with the ligatured renal afferent vein (the "ligatured" kidney) is never stronger in nitrogen than that of the kidney retaining its venous supply (the "normal" kidney).

Improved Experiments to Determine the Amounts and Total Nitrogen Strengths of the Samples of Urine.

In these experiments[2] I injected either urea sulphate (0·25 gm. dissolved in 100 c.c. 0 5% saline), urea (1 gm. dissolved in 100 c.c. 0 6% saline) or sodium sulphate (0 2 gm. dissolved in 100 c.c. 0·5% saline) into the arm muscles but sometimes intravenously (vein in arm), at the commencement of each experiment (never during the course of the experiment) and collected the urine in tubes from the two kidneys in the same intervals of time. Out of thirty-three experiments attempted, eighteen were successful (in the other fifteen experiments, eleven gave either no urine at all or urine in quantities insufficient for accurate nitrogen estimation, and four were faulty). Of these eighteen successful experiments, fifteen gave the result of *the ligatured kidney producing urine greater in quantity* (in the average proportion of 1·4 : 1, i.e. the ligatured kidneys of these eighteen experiments secreted 78 c.c. and the "normal" kidneys 54 c.c. in the same time) *but weaker in nitrogen* (adding together all the nitrogen strengths of the urine samples of the two kidneys respectively, the average strengths were in the ratio of 0 7: 1) *than the urine of the normal kidney.* The fact that the quantity ratio of 1·4 : 1 was identical with the nitrogen strength ratio inverted (1·4 : 1 = 1 : 0·7) was doubtless a coincidence, but it proves that on the whole *the amounts of total nitrogen excreted by the ligatured and "normal" kidney respectively were equal* (the ligatured kidneys excreted a total of 0·033474 gm. and the "normal" kidneys a total of 0·033750 gm.). In other words, *the ligaturing of the renal afferent vein in each of these frogs makes practically no difference to the total amount of nitrogenous matter, which these ligatured kidneys excrete as compared with the "normal" kidneys, despite the fact that the ligatured kidneys are, on the current view, deprived of three-quarters of their total blood-supply by the ligaturing of the renal afferent veins.* These results, obtained in 15 out of 18 experiments must be regarded as the normal results. and the three abnormal results must be regarded as having been due to the preponderance of a particular factor, such as, e.g. the well-known alternation of activity of the kidneys (e.g. at the commencement of the experiment when secretion is most vigorous the "normal" kidney may have been at the "flood tide" of its activity and, if the experiment was brief, may have therefore secreted more than the ligatured kidney for this reason) or extra active absorption of water by the belly skin (the influence of which will be appreciated when I have explained the cause of the normal results).

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[1] Full details of the mode of preparation of the frog are supplied in Appendix F.

[2] Details of these and following experiments will be published in the Indian Journal of Medical Research: January, 1923.

Further Experiments to Determine the Amounts and Chloride (as NaCl) Strengths of the Samples of Urine.

Twenty-three experiments were attempted altogether (similar to those already described save that the urine was estimated for chloride by Dr. A. P. Sircar, instead of for total nitrogen), of which fourteen were successful. Out of these fourteen experiments, ten gave as their result that *the urine of the ligatured kidneys was greater in amount* (the total amount of urine secreted by the ligatured kidneys = 18·15 c.c. and that by the "normal" kidneys = 10·65 c.c., the ratio therefore being 1 7 : 1) *and contains a lower percentage of chloride as compared with the urine of the "normal" kidneys.* I may add that in five of these experiments 0·6% saline was placed in the dish instead of water and in all these cases the normal result was obtained : in all the four experiments with abnormal results, water was in the dish

The normal results confirm me in my denial that the results obtained by Bainbridge, Collins and Menzies (see Part II, p.) are true. It will be remembered that these authors maintain that, with a venous supply, the kidney secretes urine weaker in chloride compared with the urine which is secreted when the venous supply is eliminated (the contention being that the venous supply enables the tubules to absorb more actively). The results just recorded, on the contrary, prove that a larger venous supply than usual *adds* chloride to the urine.

The Interpretation of the Preceding Results

Since it appears to be still a matter of dispute as to whether quantity of urine depends on the rate of flow or on the pressure of the blood or other perfusing fluid, and since I have not met with any statement implying recognition of the fact that the composition of the urine depends, other things equal, solely on the pressure of the blood supply, and since also the acceptance of the truth in these matters is all important not only for my explanation of the results described in this Part but for the appreciation of the arguments to be advanced in the next Part (Part IV) I have found it necessary, even in this Abstract of my Memoir, to quote the experiments described in Appendix G in full. The results of these experiments make it quite clear and beyond dispute (1) that quantity of urine is, other things equal, directly dependent on the rate of flow × volume of the fluid or blood perfused, i.e on the *flow* of the fluid or blood through a given length of capillary in a given time; (2) that the composition of the urine, on the other hand, is dependent, other things equal, on the *pressure* of the perfusing blood or fluid—the greater the pressure the less the percentage of nitrogen and the greater the percentages of chloride and water, and vice versa. Thus quantity of urine is. other things equal, dependent on rate of blood flow and not on blood pressure, and quality of urine is, other things equal, dependent on blood pressure, and there is every reason to believe that all other glandular secretions conform to these rules (see Part IV).

Taking these truths as granted, the explanation of the results of the preceding experiments is quite simple and congruous with that of all other results described in this Memoir. In these preceding experiments, it has first to be recognized that the "normal" kidney retaining its venous supply is not normal in the sense that its venous supply resembles closely that of a kidney in a frog which has neither of its renal afferent veins ligatured. On the contrary, owing to the ligature of the renal afferent vein of the ligatured kidney. the venous blood from the legs has to return to the heart via two vessels (the remaining renal afferent vein and the anterior abdominal) instead of three, and the remaining renal afferent vein therefore contains appreciably more blood than usual. This increase of blood pressure in the renal afferent vein of the "normal". kidney is responsible for all three results recorded in the preceding experiments, viz. the greater quantity of urine secreted by the ligatured kidney and the greater percentages of nitrogen and chloride in the urine secreted by the "normal" kidney. The excess of blood in the renal afferent vein of the "normal" kidney raises the pressure in the renal venous meshwork and this retards the flow of the arterial blood in the intertubular plexus,[1] and since quantity of urine is strictly dependent on the flow of this arterial blood, the quantity of urine secreted by the "normal" kidney is in consequence less than the quantity of urine secreted by the ligatured kidney,[2] which is altogether devoid of a venous supply.[3] Again, the excess of pressure in the renal afferent vein of the "normal" kidney causes the venous blood to mix to a slight extent with the arterial blood in the intertubular plexus (vide Part I on the results of a slight excess of venous pressure in perfusion experiments) and this venous blood containing a greater percentage of nitrogen[4] than the arterial blood, the result is that the urine secreted by the "normal" kidney is slightly stronger in nitrogen than the urine of the ligatured kidney. It is true that the increase of pressure in the intertubular plexus will lower the percentage of nitrogen in the urine but this lowered strength in nitrogen is masked by the raised strength due to the admixture with the nitrogen-rich venous blood (vide Part I). As regards the superior chloride strength of the "normal" kidney urine, since this probably has no connection with the mixture of the venous with the arterial blood, it can only be due to the increased pressure of the arterial blood in the intertubular plexus (Appendix G).

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[1] This retardation of the arterial flow by raising slightly the pressure in the renal afferent vein I have proved on many occasions in perfusion experiments: on the other hand, successive increases of pressure in the post-caval appear to be almost wholly ineffective in retarding the arterial flow (see Appendix G), possibly on account of extravasation. Perhaps this difference, if it exists, is correlated with the fact that the renal venous meshwork itself offers considerable resistance to the flow of the venous blood through it.

[2] Gurwitsch (20), who apparently on the basis of two experiments (!) comes to the conclusion that the ligatured kidney usually excretes *less* urine than the unligatured, appears to imagine that the opposite (i.e. my) result would be necessarily in favour of Ludwig's theory—the lack of absorption of water in the ligatured kidney tubules accounting for it. But, unless he supposes that the stationary arterial blood which is laid up in the half-filled renal venous meshwork of the ligatured kidney is almost as potent functionally as the rapidly circulating venous blood which occupies the over-filled renal venous meshwork of the "normal" kidney, it is difficult to imagine that a kidney with at least three times (see Part I) more blood supply (supposed to be rushing through its intertubular capillary system) than the ligatured kidney can surpass the ligatured kidney so little in its powers of absorption of water from the glomerular filtrate as to reduce the output of urine only by $\frac{1}{1\cdot4}$. If quantity of blood counts, the reduction in urine output should be $\frac{1}{3}$.

[3] I have ascertained in a number of careful experiments that the emptying of the renal afferent vein does not accelerate the flow of the arterial blood in the intertubular plexus and therefore does not increase the quantity of urine produced by the kidney.

[4] The venous blood in these experimental frogs is even richer in nitrogenous material relative to the arterial blood than normal frogs because in the former *P* (see Part I, p.) becomes artificially greater in proportion to *B* owing to the latter being lowered in value by the removal of tissue in the preparation of the frog.

The few exceptional results which I have described in connection with nitrogen and chloride strengths I believe to be due to the belly-skin absorption factor. Though the absorptive area of belly-skin [1] presumably pours the absorbed water into the anterior abdominal vein, the blood in which does not supply the kidneys directly, yet small ventral absorptive areas of skin on the thighs are drained by factors which open into the renal afferent veins and so do "supply" the kidneys, and it is evident that if either water or salt is absorbed by the skin, this would reach the kidneys sooner via the renal afferent veins than that absorbed by the belly skin. Marked absorption of water will dilute the venous blood and when this admixes with the arterial blood in the "normal" kidney, the result may occasionally be that the "normal" kidney secretes urine weaker in nitrogen and chloride than that of the ligatured kidney. According to Pesci and Andres, the frog's skin behaves as a semi-permeable membrane which permits water to leave or enter according to the hyper- or hypo-tonicity of the solutions—hence water may occasionally enter in great quantity. On the other hand, according to these authors, substances, like sodium chloride, dissolved in the water, are always absorbed, and in the case of those frogs which were placed in saline during the experiment, it is not surprising that the "normal" kidney always secreted urine stronger in chloride, because the venous blood probably contained more chloride than the arterial blood. These are the only explanations I can offer in order to account for the few exceptional results which I obtained.

That the above explanation of the main results is the true one is proved by the results of the perfusion experiments which I have stated in Part I and by those which I have described in Appendix G. In Part I, I showed that when there was no excess of pressure in the renal afferent vein containing fluid stronger in nitrogen ("46 fluid") than the arterial fluid, then the urine secreted was of identical strength with that secreted by the kidney with fluid of the same nitrogen-strength ("30 fluid") as the arterial fluid in its renal afferent vein. On the other hand, I showed that a very small excess of pressure (flow) in the renal afferent vein causes the "46 fluid" to affect the urine secreted by the actual penetration of the renal afferent vein fluid into the intertubular plexus. The explanations of the differences in the amounts of urine secreted and in chloride strengths are also, as I have already stated, in accordance with the results described in Appendix G.

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[1] This area can be well demonstrated in *Rana tigrina* by immersing the animal for a few seconds in ammonia or acid solution, when it assumes a distinct red colour.

Further, if the above explanation of difference of nitrogen strength be the true one, it is evident that if the arterial fluid be made relatively so strong in nitrogen as to render the increase of strength in nitrogen, due to the contribution from the leg tissues, in the renal afferent vein fluid relatively insignificant, then the urine secreted by the normal kidney will be no stronger in nitrogen than that of the ligatured kidney, since any slight increase due to the nitrogen from the leg tissues will be counterbalanced by nitrogen-weakening due to the increase of pressure. I have proved this in four experiments (not recorded). Further it is evident that if the nitrogen contribution from the leg tissues be eliminated by joining the iliac artery directly on to the renal afferent vein by means of a **U** tube (constricted so as to avoid excess of pressure), then the urine of the ' normal" kidney will certainly be no stronger in nitrogen than that of the ligatured kidney. I have proved that this is so in six perfusion experiments. The results of all these experiments therefore confirm the explanation which I have provided to account for the results I have described in this Part III.

Repetition of Gurwitsch's Experiments on the Excretion of Dye Respectively by Kidneys Deprived of their Renal Afferent Venous Supply and by " Normal" Kidneys in the same Frog.

Gurwitsch states that in frogs operated on as usual from the dorsal surface, with dye injected into the blood, the urine of the ligatured kidney becomes only slightly coloured whereas that of the "normal" kidney is much more deeply coloured This result is similar to the results I have obtained for nitrogen and chloride. I repeated these experiments of Gurwitsch on three occasions. In each experiment I injected into the arm muscles several c.c. of a solution of 0·2 gm. of sodium sulphate dissolved in 100 c c. of 0·5% saline as a diuretic, and later, when urine was being excreted, several c.c of a deep-blue solution of indigo-carmine in 0·5% saline, also into the arm muscles. The ligatured kidney urine of the first experiment was, in intensity of coloration,[1] to that of the

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[1] The samples of urine were placed in narrow tubes of equal calibre and their depths adjusted until they were of the same colour viewed vertically over white paper.

"normal" kidney as 5 : 6; in the second experiment as 4 : 6 and the third experiment as 4·5 : 6. These results therefore are similar to the chloride strength results and doubtless the same explanation applies to both—indigo-carmine dye apparently acts like chloride, increase of fluid pressure increasing its percentage in the urine.

Some Theoretical Considerations.

In Parts I. II, III I have proved conclusively both that the so-called "renal portal" system is devoid of function and that it is distinct and separate from the intertubular plexus. It remains to be added that I have already supplied in my previous paper (44) a raison d'être for the "renal portal" system. This, stated briefly, is to be found in the confined position in which the kidneys of most of the lower Vertebrates develop. Being pressed for space in which to develop, the kidney tubules project during development into the lumen of the posterior cardinal or other adjacent venous sinus, the thin wall of the sinus being pushed in front of the wall of each tubule (cf. e.g. the development of the excretory organ of Crustacea in which the lumen of the originally wide excretory organ of Crustacea in which the lumen of the originally wide excretory sac becomes converted into an apparent network of tubules by the in-pushings of the adjacent blood sinuses—vide 47: in this case the blood tissue is developmentally active and like all other capillarizations, penetrates the tissue of the organ to be supplied for functional purposes, but in the case of the "renal portal" system the blood tissue is passive and itself becomes fenestrated by the adjacent organ apparently for mechanical reasons only). The successive antero-posterior developments of the kidney (pro-, meso-and meta-nephroi) follow the paths of the posterior cardinal sinuses, being relatively far apart anteriorly and near the median line posteriorly, and the kidneys thus apparently select the site of the veins because development is most easy in this position—there is more space. In the Mammals and Birds, on the other hand, with powerful hind limbs, the limb veins need direct and easy access to the post-caval, and the kidneys in such active animals become greatly enlarged relative to the rest of the body, [1] and for both these reasons the development of a "renal portal" system is impossible

We conclude then that the vascular supply of the kidney is identical throughout the Vertebrate series and that it is the arterial supply alone which is utilized for urine secretion. This conclusion however, while it clears the ground of a misconception which has hitherto misled experimental effort and vitiated inferences drawn, does not by itself assist us much in connection with the larger problem as to whether the urine is secreted by the tubules or by the glomeruli, or by both. We are as far off as ever from being able to decide between the rival modified theories of Ludwig and Bowman, since it is now useless to say, e.g. that a kidney with a ligatured renal afferent vein is thereby deprived of three-quarters of its total blood supply and that since its tubules evidently cannot excrete as much urine from the intertubular blood under these conditions as the normal kidney with a venous supply, therefore the excess of urine excreted by the ligatured kidney in the experiments described above is definitely in favour of the neo-Ludwig theory—lack of intertubular blood involving lack of absorption of water from the glomerular filtrate giving an excess of urine. On the contrary, we now know that the blood used for secretion remains about the same in both kidneys and that it is only due to experimental imperfection (the artificial raising of the venous pressure in the " normal " kidney) that the urine samples of the two kidneys differ slightly in amount and quality. This imperfection in these experiments, and the intentionally-produced excess of pressure in one renal afferent vein in the experiments of Part I do however provide a clue which inevitably leads us to adopt, as has already been explained, a very much modified version of the Bowman-Heidenhain theory—the Tubule cum Rete theory,[1] which may be regarded as the theory of Bowman with the glomerulus as a source of urine left out. According to the modified glomerular-filtration and tubule-absorption theory of Ludwig (the neo-Ludwig theory as I shall call it), so ably put forward by Cushny (17), the mere facts that dye, potassium ferrocyanide and other substances can be perfused through the renal afferent veins at normal pressure without appearing in the urine (Part I) prove nothing because if the tubules are absorptive, the presence of these substances even in the intertubular plexus will not affect the urine filtered from the glomeruli, provided that we assume, as Cushny assumes, that the absorptive activity of the tubules is independent of the constitution of the blood supplying them. Now we have seen that this assumption is untenable. We have shown repeatedly in Part I and in the present Part III that when the fluid in the intertubular plexus does become changed as the result of excess of fluid pressure in the renal venous meshwork, causing actual admixture of the venous blood or fluid with the arterial blood or fluid in the intertubular plexus proper, then the urine immediately indicates the admixture by an alteration in composition, and this alteration in composition can only be the result of such admixture between the blood in the renal venous meshwork and the plexus, because it is impossible, with such a relatively high pressure in the glomoruli. for the venous fluid to affect the blood or fluid contained in the glomeruli (Part I). Change of composition of the blood or fluid in the intertubular plexus does then affect the composition of the urine secreted, and this is proof that the tubules secrete the urine, because no modification of an absorptive activity of the tubules would enable urine to be secreted which contains constituents present in the venous blood but absent from the arterial blood (dye and ferrocyanide present only in the renal afferent vein supply e.g.)

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[1] I have determined the ratio $\frac{\text{Wt. of Body.}}{\text{Wt. of both Kidneys}}$ in large numbers of individuals of all classes of Vertebrates. The results will be published shortly.

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[1] We can hardly call a theory which regards the glomerulus as a mere rete mirabile devoid of any filtering or secreting properties, neo-Bowman; on the other hand, neo-Ludwig is preferable to the expression " modern " coined by Cushny for his modification of Ludwig's theory since the latter term begs the question The neo-Ludwig theory only differs essentially from that of Ludwig in assuming that the tubule cells absorb Locke's fluid: the Tubule cum Rete theory, on the other hand, differs from that of Bowman in omitting one half of Bowman's ideas concerning the mechanism for the production of urine.

That the tubules can and do secrete urine, has already been proved by the experiments of Bainbridge and Beddard (3). As is well known, these investigators ligatured all the renal arteries in individual frogs and by keeping some (the majority) in an atmosphere of oxygen and others in air (thus preventing the necrosis of the tubule epithelium which occurred in Schmidt's and Beddard's experiments—36, 8, obtained (after injecting strong diuretics into the lymph sacs) urine in measurable quantity (i.e. at least 0·5 c c.) in 11 out of 22 experiments. This urine was found to contain " most of the normal urinary constituents "—all that were tested for. Since in these experiments an arterial circulation was absent, it was all-essential from the point of view of deciding whether the urine excreted was tubule or capsule-derived. to determine whether or not the blood supplied by the two renal afferent veins ever intruded so far into the intertubular capillary plexus as to reach any glomeruli. This necessity was apparently complied with when, at the end of each experiment, the vascular system of the frog was well washed out (from the aorta) with saline " and then thoroughly injected with a saturated solution of soluble Prussian blue " (presumably at a pressure not less than normal arterial pressure). This injection was made by the authors apparently solely in order to be certain that all the branches of the renal arteries had been severed by cautery and they did not recognize the possibility of the dye reaching the glomeruli from the intertubular capillary plexus; nevertheless the injection served both purposes, provided that the dye was injected at a pressure not less than the normal arterial pressure. In 6 out of the 11 successful experiments, the authors expressly state that "no glomeruli were injected" and that the tubule epithelium "appeared normal"; on the other hand, in two of the remaining five experiments glomeruli were found to be injected at the extremities of the kidneys, and it seems probable that this was due to influx from the intertubular capillary plexus rather than to some twigs of the renal arteries having remained uncauterized,[1] since we have seen that Nusshaum's and Beddard's statement that "it is impossible to inject the glomeruli from the renal-portal vein" is untrue, provided that the pressure in the vein be sufficient.

These experiments on the whole therefore (and possibly those of Nussbaum (30) and Halsey (21) who similarly obtained urine from frogs with cut-out renal arteries, after injecting diuretics directly into the blood—which, as Cushny points out, would therefore be more potent than in Bainbridge and Beddard's experiments—, though they did not sectionize the kidneys afterwards to see if glomeruli had been included in the circulation) afford good evidence that the tubules secreted more or less normal urine (of course in reduced quantity as compared with normal frogs because of the lack of flow) without any assistance from the glomeruli. Since we cannot accept Bainbridge and Beddard's compromise between the two rival theories of Ludwig and Bowman, viz. that "both the glomerular and tubule epithelia definitely secrete urine, and in all probability both can secrete much the same urinary constituents in solution," if only because we object to the supposition that much unlike structures as the small capsules with their thin squamous epithelium and the long tubules with their thick walls of truly glandular cells perform identical functions, we are bound to conclude that the tubules alone secrete the urine, the function of the glomeruli being altogether different (see Part IV).

Bainbridge, Menzies and Collins (5) maintain, however, despite the conclusive evidence to the contrary provided by the control dye injections of Bainbridge and Beddard, that urine formed by perfusion through the renal afferent veins, the arteries being ligatured, is always produced by the fluid perfused reaching the glomeruli, because whenever, in their experiments, urine was secreted as the result of very high pressure in the perfusion fluid, subsequent injection of Berlin blue always resulted in the dye being found in the glomeruli, whereas when, with low pressure, urine was not secreted, few or no glomeruli were found to contain the dye. This, I may remark without disrespect to these authors, is an admirable practical illustration of a logical fallacy. Because with a venous perfusion pressure of 28–30 cms. urine is secreted and the glomeruli are found to be injected, and with a perfusion pressure of 10–12 cms., urine is not secreted and the glomeruli are found not to be injected, the conclusion is drawn that the glomeruli secrete the urine. These two pressures were apparently the only pressures employed by these authors, and it is evident that in order to establish their conclusion logically, the possibility of perfusing with a pressure of *intermediate* intensity which might have resulted in urine secretion *without the glomeruli becoming injected* should not have been excluded. In other words, it is to me certain that the high pressure (28–30 cms.) which injected dye into the glomeruli also injected the perfusion fluid into the intertubular plexus (as defined by me) as well as the glomeruli, whereas the low pressure (10–12 cms.) which failed to inject dye into the glomeruli also failed to inject fluid into the intertubular plexus to a sufficient extent to produce urine. This source of fallacy was of course not evident to Bainbridge, Menzies and Collins because they did not recognize the separateness of the intertubular plexus from the renal venous meshwork.

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[1] Each operation however was done from the ventral side, when it is not so easy to be certain that every arterial twig has been severed as it is in a dorsal operation.

The proof that this interpretation of the results of Bainbridge, Menzies and Collins is the correct one is to be found in the results of five of my own experiments on dye injection already briefly referred to in Part I (p.). In these experiments the dye was injected via one renal afferent vein at a pressure of not more than 3 or 4 cms. above normal, *the arterial circulation being in full force*, and I obtained distinctly *blue urine.* On examining sections of these kidneys, dye was *always* absent from the glomerular capillaries and capsules though present in some of the intertubular capillaries, in the renal venous meshwork and in tubule lumina. These results prove conclusively that the tubules secreted the dye, and are much more reliable than the experiments of Bainbridge, Menzies and Collins, because in such experiments with venous flow only, the tubules only secrete providing that diuretics are present and that the *volume* of fluid injected into the tubular capillaries is considerable (see Part IV), and the pressure necessary to force in a lot of fluid[1] is generally sufficient to enable it to penetrate into the glomeruli in varying amount. At least this is the conclusion I came to when performing six other experiments similar to those of Bainbridge, Menzies and Collins and found, as these authors say, that almost invariably, when urine was secreted, a few glomeruli (a very small percentage of the total number) showed traces of the dye.

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[1] It is also probable that when the narrow sinusoids or rather capillaries of the intertubular plexus are empty and probably contracted, it requires much more force to re-open and refill them than it does to cause venous fluid to penetrate into them when they are already open and contain fluid. Hyrtl's description (26) of the narrow openings of the intertubular plexus capillaries into the large channels of the renal venous meshwork must be borne in mind.

PART IV.

THE TUBULES VERSUS THE ENCAPSULATED GLOMERULI—A BRIEF CONSIDERATION OF THE PROBABLE FUNCTIONS OF THESE TWO PARTS OF THE VERTEBRATE KIDNEY.

CONTENTS.

Some Facts subversive of the neo-Ludwig Theory of Kidney Secretion.
(1) Quantity of Urine is dependent upon the Quantity of Blood or other Perfusing Fluid (Volume × Rate of Flow) traversing the Intertubular Plexus and not on Fluid Pressure in the Glomeruli.
(2) Reversal of the Current of Perfusing Fluid through the Kidney.
(3) The Quality of the Urine is dependent on Fluid Pressure.
(4) The Secretion of Substances solely present or present in Excess in the Renal Afferent Veins of the Frog when the Fluid Pressure in the Renal Afferent Veins is excessive relative to the Pressure in the Arterial Fluid.
(5) The Increase and Decrease of Urine due to the Increase and Decrease of the Osmotic Pressure of the Fluid traversing the Renal Afferent Veins
Alternative Hypotheses to account for the Enclosure of the Glomerulus in the Capsule.
A Consideration of some other Arguments used in support of the neo-Ludwig Theory.

In Parts I–III of this Memoir it has been necessary on several occasions to refer to current theories concerning the mode of function of the kidney, since our interpretation of the significance of certain experimental results not infrequently depends on the adoption of one or other of these. Three principal theories may be said to exist, two of which have received much recognition and the third but little. The first is the Bowman-Heidenhain theory, the second the neo-Ludwig theory (the "modern theory" of Cushny, 17), and the third that which I have termed the Tubule cum Rete theory. To be brief I may say that I do not propose to discuss the Bowman-Heidenhain theory, for the simple but conclusive reason that a theory which considers that the functions of such dissimilar structures as the thin-walled diminutive capsule with its contained glomerulus and the thick-walled typically glandular elongated tubule are of essentially the same order (17, pp. 40, 56) is *ipso facto* self condemned: as Cushny remarks, if one can undertake the functions of the other, what call is there for the development of "this very special apparatus," the capsule with its glomerulus? There remain then the neo-Ludwig theory, which as is well known, assumes filtration through the glomerulus of all the non-colloid contents of the blood with reabsorption in the tubules of Locke's fluid——the portion of the filtrate most required to be retained by the body——,and the Tubule cum Rete theory, which is the very antithesis of the neo-Ludwig theory in that it assumes that all the constituents of the urine are secreted by the tubules.[1] The function of the glomerulus, according to the Tubule cum Rete theory, is that which is probably to be attributed to most or all other forms of retia mirabilia, viz. the reduction of the arterial pressure (since high blood pressure in the intertubular plexus means excessive loss of salt and deficient elimination of nitrogen, i.e. the reversal of the result demanded by the body) and the retardation (rapid flow in the intertubular plexus involving undue loss of water from the body) and making continuous of the arterial flow, while maintaining a large volume of blood. The way in which the glomerulus produces these effects will be explained below, and suggestions will also be offered in explanation of the well-known but little understood fact that the glomerulus, unlike most other retia mirabilia, becomes encapsuled.

For the sake of brevity I shall not attempt to discuss the relative values of these rival theories from every point of view, all that I shall undertake is to state certain facts, mostly derived from my own work. which I believe to be fatal to the neo-Ludwig theory, to reconsider some other facts which are either for or against this theory, and to answer certain objections which have been or probably will be levelled against the theory which I believe to be the true one.

Some Facts subversive of the neo-Ludwig Theory of Kidney Secretion.

(1) Quantity of Urine is dependent upon the Quantity of Blood or other Perfusing Fluid (Volume × Rate of Flow) traversing the Intertubular Plexus and not on Fluid Pressure in the Glomeruli.

If the capillary walls of the glomerulus and the capsule wall filter off only the non-colloid constituents of blood, then both blood pressure and blood flow must be important factors in filtration, but in perfusion experiments in which the whole of the circulating fluid is filterable, fluid pressure can be the only factor concerned. If glomerular filtration be a fact, quantity of urine in perfusion experiments will other things equal, be solely determined by fluid pressure in the glomerular capillaries. and rate of flow of the fluid will be of no account. This conclusion is directly contradicted by the facts which prove beyond doubt that in perfusion experiments *quantity of urine is, other things equal, directly dependent, not on rate of flow alone, not on volume of the perfusing fluid alone, but on both volume and rate*

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[1] The only authors known to me who have previously advocated this theory are Lamy and Mayer (28).

of flow, i.e on the quantity of fluid which flows through a given length of capillary in a given time—and has no connection with fluid pressure[1] *save in so far as pressure increases rate of flow.* In Appendix G (Part III) I have given the results of nine perfusion experiments (six described in some detail and three mentioned) in proof of the statement that quantity of urine depends on rate of flow of the perfusing fluid and not on fluid pressure. In Exp. Ser. A. I. P. increase of pressure occurs in the aorta and this produces an increase of rate of flow in the intertubular plexus, and the increased rate of production of urine must be due to one of these, though even here there is more proportionality between the initial increases of rates of flow and the increased quantities of urine than there is between these latter and the increases of pressure. In the Exp. Ser. P.C.I.P. the increase of pressure occurs in the post-caval and this pressure must to a large extent be transmitted up the intertubular plexus to the glomeruli, so that in this series we again obtain increase of pressure in the glomeruli but associated with a decreased rate of flow in the intertubular plexus. Since in this series the quantities of urine produced show no relation whatever to the increase of pressure, it follows that the former must be a consequence of the rates of flow, since, like these latter, they fluctuate about a common level. Thus in the A.I.P. series increased output of urine may be correlated either with increase of pressure or increased rate of flow; in the P.C.I.P. series, on the other hand, the output of urine is evidently correlated with the rate of flow, and, we may therefore conclude, is also correlated with rate of flow in the series A.I.P.[2]

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[1] De Sousa (19), among others, has come to identical conclusions regarding the relations between quantity of urine and rate of blood flow and blood pressure from experiments conducted on the living animal.

[2] I give the data in the two Series A.I.P. and P.C.I.P. for comparison.

Series A.I.P. Increase of Aortic Pressure=20 cms., 30 cms., 40 cms.

Increase of Rate of Flow = (Exp. 1) 17·3 c.c.—50 c.c.—115 c.c.
(Amounts perfused per 30 minutes) (Exp. 2) 28·2 c.c.—82 c.c.—133 c.c.
(Exp. 3) 15·7 c.c —47·5 c.c —80 c.c

Increase of Urine Output =(Exp. 1) 0·5 c.c.—1·2 c.c.—1·25 c.c.
(Amounts secreted in 30 minutes) (Exp. 2) 0·18 c.c.—0·85 c.c —1·2 c.c.
(Exp. 3) 0·38 c.c.—0·87 c.c.—0·95 c.c.

Series P.C.I.P. Increase of Post-caval Pressure=(Exps. 1, 3, 4) 0 cm —2·5 cms.—5 cms.—7·5 cms.
(Exp. 2) 0 cm.—5 cms. —7·5 cms.

Rates of Flow (Exp. 1) 76 c.c.—94 c.c —115 c.c.—131 c.c.

Cushny suggests that one reason why, when pressure in the glomerular capillaries is raised by increased resistance in the post-caval, the output of urine is not increased (when in living animals the arterial flow is retarded by constriction of the renal vein the urine decreases in quantity) is because the capsular epithelium becomes asphyxiated by the retardation of the blood flow, and he adds that the capsule epithelium "responds rapidly" to such asphyxia. To this suggestion I may reply that, as shown by the well-known examples of the frog's lung and the abdominal skin of the frog, the more moribund an epithelium the more easily it filters, and Cushny himself (p. 101) refers to Sollmann's demonstration that the "dead" kidney can produce a plentiful "exudate" when the pressure of the perfusion fluid is raised; moreover there is no evidence whatever in support of the assertion that the capsular epithelium "responds rapidly" to asphyxiation by becoming non-filtrative. Again, according to Cushny, Tammann suggested that owing to the slow circulation of the blood in the glomerulus, filtration of water must lead to an excessive concentration of the colloids remaining in the blood and therefore to an increase of the osmotic resistance offered by these colloids to further separation from the non-colloids, but this suggestion does not apply to the results of perfusion experiments with fluids devoid of colloids, and will probably be falsified when reverse current experiments (vide *infra*) are performed with blood as the perfusing medium. Finally, Ludwig suggested in 1861 that the non-increase (perfusion fluid) or actual decrease (blood) in quantity of urine when the efferent vein is constricted is possibly due to another secondary cause, viz. "that the swollen veins press upon the tubules in the medulla and narrow or close them so that no urine can reach the ureter" (17, p 105). The reply to this suggestion is that given such a pressure producing swollen veins the tubules cannot only secrete urine, but can secrete urine at a much greater rate than when the veins are not swollen, provided

(Amounts perfused per 30 minutes)	(Exp. 2) 56·5 c.c.—71 c.c.—66 c c. (Exp. 3) 35 5 c.c.—42·5 c.c.—36·3 c.c.—33·3 c.c. (Exp. 4) 85 c.c.—99 c.c.—102 c.c.—100 c.c.
Rate of Urine Output (Amounts secreted in 30 minutes)	=(Exp. 1) 0 87 c.c.—1·4 c.c.—0 5 c.c.—0·33 c.c. (Exp. 2) 0·72 c.c.—1·4 c c —1·25 c.c. (Exp. 3) 0·7 c.c.—0·75 c.c —0·41 c.c.—0·36 c.c. (Exp. 4) 0·75 c.c.—0·62 c.c.—0·55 c.c.—0 62 c.c.

that (in the total absence of diuretics) the fluid in the swollen veins *flows*. This condition of things can be brought about by perfusing the kidney in the *reverse* direction to the normal, i.e. through the renal vein or veins to the artery or arteries instead of vice versa. I performed five such experiments on the frog and four on the rabbit, the results of which are given in Appendix H, and they provide a sufficient disproof of the suggestion put forward by Ludwig, and, at the same time, and in conjunction with the results of Appendix G (Part III), a sufficient demonstration of the truth of the view that quanti-ty of urine is, other things equal, dependent on rate of flow and volume (i.e. on the flow) of the perfusing fluid, and that hydrostatic pressure in the glomerulus (except in so far as it is a cause of flow) and absorption in the tubules have nothing to do with urine production Some rate of flow is, under most conditions,[1] absolutely essential for secretion, but the amount of secretion will be small or even nil unless there is also volume (well shown when, the renal nerves being stimulated, the renal capillaries contract and the urine output is diminished, though the blood pressure remains unaltered and the rate of flow must be increased).

Additional confirmation of this view is afforded by the familiar fact that in both the salivary gland (Starling, 40, p. 668) and the liver (Schafer's "Text-book of Physiology," Vol. I, p. 565) blood flow is the chief factor concerned in quantity of secretion, and not blood pressure, and the same fact doubtless holds for the pancreas (27) and all other glands. In all these glands increased output of secretion[2] always, other conditions being the same, follows dilatation of the gland capillaries, and though it is sometimes assumed that this dilatation is solely due to a local increase of blood pressure (even when, as in the case of the kidney with the splanchnic nerve branch cut, the pressure in the artery remains constant) yet it seems quite as feasible to assume that the dilatation is due to relaxation of the capillary walls, the resulting lowering of resistance facilitating inflow of blood and thus producing that volume of blood which is so essential to secretion, even though the rate of flow be slightly reduced.

Again, the results of the experiments described in Appendix C, Part I, prove that marked increase of osmotic energy of the fluid traversing the renal venous meshwork can accelerate the rate of flow of the fluid through the intertubular plexus

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[1] Urine can also be produced from practically stationary blood or fluid in the intertubular plexus, provided that there be a sufficient volume of blood or fluid and that this contains sufficiently strong diuretics, i.e. diuretics can take the place of flow.

[2] As also increased absorption in the gut or placenta, or, as in inflammation absorption of toxic or useless matter, and all other forms of blood activity.

(though the arterial "head of fluid" pressure remains constant) and cause increased output of urine, provide still further proof of the statement that fluid pressure in the glomerulus is not concerned with the production of quantity of urine.

Since the results of experiments dealing with filtration through animal membranes prove that the quantity of filtrate rises with the pressure (though in lower ratio in most cases) and that with a fluid devoid of unfilterable constituents, rate of flow is of no account as a factor producing quantity of filtrate, it follows that the hypothesis of glomerular filtration applied to the mode of function of the kidney cannot be entertained.

It may however be objected that filtration by the kidney, i.e. the production of urine more or less identical in composition with the perfusing fluid, or at least the portion of it injected, undoubtedly does occur under certain conditions, as e.g. when Ringer's fluid is injected into the blood-stream in such quantities as to render relatively insignificant the colloid content of the blood, or when Ringer's fluid or simple saline is perfused through the kidneys at a certain pressure, but to admit this is not to admit the hypothesis of glomerular filtration. On the contrary, facts to be stated below afford definite proof that this filtration, like all other forms of kidney secretion, occurs through the walls of the tubules, which, under these peculiar conditions, fail to modify the composition of the perfusing fluid. Filtration in the dead kidney certainly occurs through the tubule walls, as may be seen when a kidney is first perfused via the artery with say chromic or picric acid fixative (the filtrate exuding from the ureter being small in quantity and soon ceasing) and afterwards perfused in the reverse direction via the renal vein (when the filtrate is large in quantity and continues for a long time), and if this be the case in the dead kidney, what reason is there for supposing that it is not the tubules which filter when the same results are obtained in a similar experiment with saline on a living kidney ?[1]

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[1] It has been argued that the demonstration that the dead kidney can pass fluid from the vessels into the tubules is proof that the "urine" of ordinary saline perfusion experiments is also a mere filtrate, and not a true secretion. But, according to Cushny, true micturated urine is itself only a filtrate (modified by tubule absorption) and supporters of the neo-Ludwig view cannot therefore object to the results of perfusion experiments on that score. What they have failed to recognize is that the filtrate comes from the tubules and not the glomeruli. The chief point to notice however is that what is practically filtration (i.e. passage of substances without concentration) does occur under abnormal conditions even in the living organism (as when the blood contains a great excess of water) and if the dead kidney is proved to filter via the tubules and not the glomeruli, then the living kidney almost certainly does likewise. To argue that the fluid turned out by the ureter in saline perfusion experiments is not a secretion in the sense that micturated urine is, is to suppose that the kidney is

(2) *Reversal of the Current of Perfusing fluid through the Kidney.*

In nine experiments (five on the frog and four on the rabbit—vide Appendix H) I carefully compared the results of perfusing the kidney via the renal arteries (the ordinary direct current) and perfusing in the reverse direction, i.e. in at the renal veins and out by the renal arteries. In the case of the frog I perfused 0·6% saline plus 0·05% urea at 24 cms. pressure at room temperature first through the aorta (the systemic and iliac arteries and the renal afferent veins being ligatured) and then through the post-caval (the renal arteries being cut) at the same pressure. In the case of the rabbit I perfused 0·9% saline plus 100 c.c. fresh human urine added to each 2,000 c.c. of the saline at 100 cms (water) pressure at about blood temperature first through the renal arteries of both kidneys and then through the renal vein of one kidney, the other kidney continuing as before as a control. In the first frog experiment the reverse current (R.C.) gave eight times the amount of urine obtained by the ordinary direct current (D.C.) in the same time and of a nitrogen strength of 0 000140 gm. per 1 c.c. as compared with the 0·000193 gm. of the direct current (the perfusing fluid was of a nitrogen strength of 0·000153 gm.). In the second frog experiment R.C. gave 8·5 times more urine than D.C. the R.C. urine nitrogen strength being 0·000153 gm. and chloride (as NaCl) strength being 0·006154 gm., as compared with the D.C. urine nitrogen strength of 0·000215 gm. and chloride strength of 0·005406 gm. Hence, as usual, the increased pressure in

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wholly indifferent to the nature of the fluid perfusing its sinusoids or capillaries. But this is absurd. When the blood in a living animal contains excess of water the first thing the kidney does is to get rid of the excess, and the water eliminated naturally contains a very low percentage of urea and other substances; similarly, when the kidney is perfused with saline, it endeavours to do the same thing, and the low percentage of nitrogen in this case is no more an argument for the excreted fluid being a mere exudation than it is for the product of hydraemia. In both cases the kidney attempts to re-instal the normal percentage of colloids, and in both cases the percentages of nitrogen and chloride are a function both of the nature and the hydrostatic pressure of the perfusing fluid.

In the cases of the salivary and pancreatic glands, these are only roused to activity when the gut is active and certain hormones are produced, and they naturally do not secrete when perfused with a saline solution devoid of these hormones; the kidney, on the other hand, depends upon no such special chemical messengers and its activity is entirely regulated by the nature of the perfusing fluid, which, to it, is a sufficient indication of the needs of the body.

To condemn saline perfusion experiments on the mammal's kidney, e.g. on the ground that it is necessarily dead under these conditions is an argument only rendered possible by the fact that nearly everybody's mind is obsessed by the idea of glomerular filtration. Glandular epithelium in general (including that of the tubules) is only developed when secretion occurs (i.e. when the substances extracted from the blood differ in concentration from those in the blood, and perhaps also when only a selection is made) but this does not inhibit glandular epithelium playing more or less the part of a filter when conditions demand that it should.

the intertubular plexus diminishes the nitrogen strength and increases the chloride strength of the urine. Similar results were obtained in three other similar experiments.

In the first rabbit experiment,[1] with D.C. through both kidneys, the left kidney secreted 5·0 c.c. urine in 30 minutes of 0·000546 gm. nitrogen strength, and the right kidney 2·6 c.c. urine of 0·000373 gm. nitrogen strength. The R.C. through the right kidney produced in 28 minutes 31·8 c.c. urine, while in the same time D.C. through the left kidney produced 4·75 c.c. urine, i.e. R.C. produced 6·6 times as much urine in the same time. The R.C. urine (two samples) was 0·000453 gm. and 0·000546 gm. nitrogen strength while the D.C. left kidney simultaneously secreted urine 0·000693 gm. nitrogen strength. In the second experiment R.C. produced 5·6 times as much urine as D C. and similar results were obtained in the two other similar experiments.

The significance of these results in connection with the present subject is that according to the neo-Ludwig theory quantity of urine is directly proportional to the fluid pressure in the glomeruli and inversely proportional to the absorbing capacity of the tubule epithelium—the absorbing capacity of the tubules presumably being proportional, as in the case of the intestinal epithelium, to the volume of fluid present in the intertubular capillaries. Now in these reverse current experiments, the fluid pressure in the glomeruli, when the current is reversed, is less than that during arterial perfusion because the fluid has first to overcome the resistance offered by the intertubular plexus, and on this account a less proportion of urine should be secreted during the reverse current ; further, the intertubular capillaries during the reverse current contain a vastly greater volume of fluid than they do during the arterial perfusion and they should therefore be more actively absorptive, and on this account also a less proportion of urine should be secreted during the reverse current. But we have seen that the reverse current produces a volume of urine five to eight times as great as that produced by the direct current, and thus once again the neo-Ludwig theory is in opposition to the facts I venture to prophesy that when this experiment is repeated on the living animal, i.e. with blood as the medium, identical results will be obtained.

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[1] Both kidneys had had all nerve connections severed so that this factor, as regards quantity of urine, was absent. All the renal nerves in the frog experiments, on the other hand, were left intact.

Another objection which may be urged against these experiments on the rabbit is that " failure of absorption from overflooding is especially liable to occur in the rabbit in which absorption is peculiarly ineffective at the best " (17, p 50). Even allowing for this factor, the excretion of the vein-perfused kidney in these experiments should still have been less instead of more owing to the decreased pressure in the glomeruli, but Cushny quotes an experiment on the rabbit in which, during sulphate diuresis, the two kidneys, perfused via the renal arteries, actually excreted at the rate of 5 c.c. per minute, and even at this rate, according to Cushny, the tubules absorbed 40% of the water passing through the kidneys, i.e. the kidneys excreted 0·26% of sulphate while the serum only contained 0·15%, so that in my experiments absorption should certainly have occurred on the neo-Ludwig view.

(3) *The Quality of the Urine is dependent on Fluid Pressure.*

The nine experiments recorded in Appendix G (Part III) afford clear proof of the statement that increase of fluid pressure causes the urine produced to contain an increased percentage of chloride and a decreased percentage of nitrogen, and vice versa—a statement which is also confirmed by the results of many other experiments. Now supporters of the neo-Ludwig view explain the nitrogen-weakness and chloride-strength of the urine obtained by increase of blood pressure in the aorta as being due to the incapacity of the tubules to absorb from the augmented volume of glomerular filtrate the normal proportion of Locke's fluid, i.e. the normal proportions of water (hence weaker nitrogen) and chloride (hence stronger chloride), despite the fact that increase of aortic blood pressure implies a correspondingly increased blood flow through the intertubular plexus supplying the tubules. If we adopt this explanation[1] for the excess of urine produced by aortic pressure, when pressure in the intertubular plexus is relatively low, and the glomerular filtrate large in volume, the urine produced under the very different conditions of increased blood pressure in the post-caval vein, when pressure in the intertubular plexus is relatively high[2] and the glomerular filtrate scanty,[3] should, according to the line of argument assumed in this explanation, be characterized by great strength of nitrogen and paucity in chloride. But the experimental results recorded in Exp Ser. P.C.I.P. (Appendix G, Part III) and illustrated by many other experiments I could quote, prove exactly the contrary to be the case—the urine of the post-caval pressure experiments is qualitatively identical with that of the aortic pressure experiments, being like it weak in nitrogen and strong in chloride.[4]

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[1] The present writer of course explains the nitrogen deficit (and chloride excess) of the urine of this pressure diuresis as being due to the excessive excretion of water (and salt) by the kidney tubules, just as the salivary glands (2, 7, 22), sweat glands (14), liver (when stimulated with salicylate, vide 35) and pancreas (23) secrete excess of water (and salt) when stimulated.

[2] The capillaries being enormously swollen, i.e. in the same condition as the capillaries in the villi when intestinal absorption is most active.

[3] An equally favourable condition for absorption of water and salt from the glomerular filtrate, according to Cushny (17, p. 49).

[4] These characteristics of urine produced during constriction of the efferent kidney vein must be known to physiologists and yet I cannot find any mention of them in Cushny (17) or any text-book. Brodie and Cullis

In other words, increase of pressure, whether it arises in the aorta or the post-caval, always has the same effect on the urine.[1] This easily demonstrable fact proves conclusively that (1) absorption in the tubule does not take place; that (2) glomerular filtration must, on this account alone, be deemed a myth: and (3) that therefore the whole of the urine is excreted by the tubules—the only possibility left.

(4) *The Secretion of Substances solely present or present in Excess in the Renal Afferent Veins of the Frog when the Fluid Pressure in the Renal Afferent Veins is excessive relative to the Pressure in the Arterial Fluid.*

As I have explained in Part I, it is possible with correct relative flows in the renal afferent veins and the renal arteries to perfuse indigo-carmine dye, potassium ferrocyanide and other substances through the renal afferent veins without these substances appearing in the urine, but if the renal afferent vein perfusion bottles be raised from 1 cm.–3 cms. so that the fluid pressure in the renal afferent veins just exceeds the normal pressure (relative to the pressure in the intertubular plexus), these substances at once begin to appear in the urine. We have also seen in Part III that the slight excess of pressure in the renal afferent vein of one kidney due to the ligaturing of the other renal afferent vein is also sufficient to cause the nitrogen-richer venous blood to produce urine stronger in nitrogen. Since the pressure in the glomeruli cannot be much less than 20 cms and if we assume that the pressure in the renal venous meshwork and intertubular plexus is as much as 10 cms., it is impossible to suppose that a rise of pressure in the renal venous meshwork and intertubular plexus of 1–3 cms. is sufficient to force the venous blood into the glomeruli (and so to cause the dye, ferrocyanide and excess of nitrogen to be filtered from the glomeruli) in view of the fact that the glomerular circulation remains in full force and at a pressure at least 7 cms. (of water) higher than that in the intertubular plexus. And if this be an impossible supposition, the only alternative is to assume that the tubules secrete the urine. I can conceive of no possible answer to this argument (more fully stated on

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(12) state that when the *ureter* is slightly constricted the urine excreted also contains excess of water (less nitrogen) and salt, but this secretion against a pressure is not the same thing as increased pressure in the blood of the intertubular capillaries, though it leads to the same results and is equally contradictory of the neo-Ludwig view of tubule absorption.

[1] Similarly the experiments of Bainbridge and Beddard (3) show that, the renal arteries being ligatured and the oxygenated venous blood in the renal afferent veins having penetrated into the intertubular plexus, the urine resulting is as rich in nitrogen as normal urine, and this is of course due to the pressure (the arterial blood supply being excluded) in the intertubular capillaries being as low as in the normal kidney.

p. 15 Part I) by supporters of the neo-Ludwig theory—it appears to me to be conclusive by itself.

(5) *The Increase and Decrease of Urine due to the Increase and Decrease of the Osmotic Pressure of the Fluid traversing the Renal Afferent Veins.*

In Part I (p. 18) I have explained that when, with correct relative flows, there is substituted in the renal afferent veins a fluid of higher osmotic pressure, both the flow of the arterial fluid in the intertubular plexus and the urine are increased in quantity. Conversely, when the osmotic pressure of the renal afferent vein fluid is diminished, then both the arterial flow and the urine are also diminished. I maintain that it is impossible to explain these results on the glomerular filtration hypothesis. It is inconceivable that the higher osmotic pressure of the renal afferent vein fluid can so affect the glomeruli as to hasten the flow of the arterial fluid through them, because the glomeruli are shielded not only by the inner and outer capsular walls but also, according to the neo-Ludwig view, by a film of filtrate. It is also inconceivable that, with correct flows, the renal afferent vein fluid can reach the glomeruli via the efferent glomerular vessels, because if it could, the quality of the urine would become changed and this it does not do; moreover, the very fact that the flow through the glomeruli is quickened would prevent the venous fluid from entering the glomeruli, quite apart from the differences of pressure. The only alternative then is to assume that the high osmotic pressure of the renal afferent vein fluid in some way causes the intertubular plexus capillaries to dilate, and the additional volume of the fluid entering the intertubular plexus gives rise to increased output of urine. If glomerular filtration were a fact the dilatation of the intertubular plexus would, by lowering the pressure in the glomerulus, diminish filtration and so reduce the output of urine, but since this is not the case, it follows that glomerular filtration does not occur.

Similarly, the decrease of urine output when a fluid of low osmotic pressure occupies the renal afferent veins can only be due to constriction of the intertubular plexus capillaries, and since constriction of the intertubular plexus should, on the glomerular filtration hypothesis, raise the pressure in the glomeruli and so augment the output of urine (especially since the constriction of the intertubular plexus would diminish the absorbing capacity of the tubules), glomerular filtration once more cannot possibly be held to account for the facts Once more I may say that it appears to me to be impossible for supporters of the neo-Ludwig view to explain these facts in accordance with that view.

Since in my opinion the evidence submitted under the preceding five headings constitutes absolute proof of the truth of the Tubule cum Rete theory, I do not propose to offer further original evidence nor to call to mind the large volume of other evidence which has already been advanced by previous investigators.

Alternative Hypotheses to account for the Enclosure of the Glomerulus in the Capsule.

From the standpoint of zoo-physiology there is but little need to adduce evidence in support of the assertion that, while the large diameter and short length of the renal artery allows a large volume of blood to supply the kidney at high pressure and rapid rate of flow, the function of the glomerulus is to reduce this pressure and retard this rate of flow to appropriate values, *while maintaining a volume of blood which is relatively large compared with that supplied to other glands.* Glands far removed from a seat of high pressure are usually intermittent in action and when functional depend for a temporarily increased volume of blood on local vaso-dilatation, the length of artery separating them from the aorta ensuring low pressure and slow rate of flow But the kidney, on the other hand, is continually and intensely active and thus needs a constant large volume of blood in its vessels and this can best be secured by proximity to the aorta provided that it is shielded against the excessive high pressure and rapid rate of flow which such proximity involves The glomeruli are thus to be regarded as the physiological equivalents of the length of artery which separates most glands from the seat of maximum pressure and this is the normal function of most kinds of known retia mirabilia, of which the glomerulus is but one example In short the glomerulus is the equivalent of a waterfall in the course of a large river near its mouth, the fall obliterating or minimizing the "pressure head" and the rate of flow, while maintaining the volume, whereas the lengths and small diameters of the arteries which supply other glands are comparable to small tributaries of the river near its source in which the volume of water is small and the "pressure head" and rate of flow not necessarily very large. In both cases the pressure and rate of flow may be about the same, but the volume of water at the base of the fall is enormously greater than the volume of water in a tributary, and the latter can only be increased in the tributary by the widening of the bed to form a pool.

But the glomerulus differs from all other known retia mirabilia in that it becomes encapsulated in a glandular tube, and it is this feature alone which, not unnaturally, has originated the idea of the blood in the glomerular capillaries parting with a portion of its water and some other constituents to form a portion of the urine; it is evident that if the glomerulus merely lay external to each tubule—adjacent to but not in contact with—the ideas of glomerular secretion and filtration would never have been advanced, and the tubules would be regarded as performing the function of excretion in precisely the same way as the urinary tubules of Leeches or Arthropods.[1] Now, quite apart from the experimental facts which disprove the idea of glomerular filtration, there exist other considerations, some of which have already been advanced many times, which should cast doubt on this idea. One is the fact that throughout the entire animal kingdom loss or the risk of loss from the body of any portion of such a valuable fluid as blood is most carefully avoided. The development of a blood system (haemocoele) is always distinct from that of the coelom, the latter in most of the lower animals being primarily a hydrocoele or cavity containing water which receives excretory matter and is drained off to the exterior[2] either by the nephrostomes of (therefore) open-ended nephridia or by special ducts or pores. On the other hand, all closed cavities which may be considered to be the precursors of a haemocoele (e g. the parenchymal spaces of Helminthes and Nemertines and the blastocoele of Rotifers, Entoproct Polyzoa and many larvae) or are haemocoeles (e.g. the perivisceral sinuses of Arthropods) are provided respectively with nephridia with closed inner extremities provided with flame-cells[3] and with renal tubes also closed internally and devoid of flame cells;[4] that is to say, the fluid in the haemocoele is never drained to the exterior by means of nephrostomes or any other outlets Further, it is extremely significant that when the coelom, drained in most animals by nephridia with nephrostomes, becomes secondarily connected with the blood system, thus assuming the function of a lymph space, the nephrostomes immediately disappear and the nephridia become of the internally-closed type. This has happened at least twice in the animal kingdom, once in the Leeches in which the restricted coelomic spaces have become secondarily continuous with the blood channels, and once in the lower Vertebrata, the kidney nephrostomes all disappearing when the coelom assumes the functions of a lymph space (9). It is also significant that the lymph never has any communication with any space of whatever kind until this is completely shut off from the external world, instances of which, in addition to the coelom already named, are the brain-cavity and the cavities of the eye-ball and auditory sac; also that in every part of the body at which the lymph does, on behalf of the organism part with water and salts to the outside or a space continuous with the outside, the cells concerned are, with one exception[1] under strict nervous control. It follows then that if glomerular filtration be a fact, it is the unique instance in the entire animal kingdom of blood freely (very freely!) filtering off into a space continuous with the outside of the body.

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[1] Or the urinary tubules of Lophobranch fishes, which, according to Huot (25) have no glomeruli in connection with them.

[2] My friend and assistant in Allahabad, Dr. Karm Narain Bahl, has recently described (1) the septal nephridia of a tropical earthworm, *Pheretima posthuma*, all of which open into the intestine in the mid-dorsal line throughout nearly the entire length of the worm This means of conserving the water which would otherwise be lost by drainage of coelomic fluid is good evidence that the capillary plexus round the nephridial tubules has in earthworms nothing to do with absorption. See also the preceding footnote which implies that the intertubular capillary plexus of Lophobranch fishes has likewise nothing to do with absorption.

[3] The "flame-cell" flagella of course play the part of the collar-cell flagella of Sponges, which is to drive fluid in the required direction This primitive mode of propulsion however is not needed in the kidney tubules of higher animals (Arthropods and Vertebrates) with their shorter, wider and less convoluted passages or superior fluid pressures and muscular ducts and is therefore lost. The presence of the flame-cell flagella (and the cilia in the Malpighian capsules of the frog and other lower Vertebrates) no more implies a constant inflow of fluid from the ends of the nephridia (or tubules) than the presence of the choanocyte flagella implies that water is passing through the gastral layer.

[4] "Tubules bathed in a blood supply are blind" (18).

Another consideration is the very familiar fact that no other capillaries in the body are known to filter off the non-colloidal constituents of blood, leaving the colloids behind: even the most watery kind of lymph[2] contains 2% of proteids. Moreover one of the conditions of lymph formation is the "chemical" influence exerted by the tissues traversed by the blood—an influence entirely absent in the case of the glomerular capillaries · nor are the liver or limb capillaries under the necessity of forcing their exudate through any membrane resembling that of the capsule—many such membranes indeed effectually prevent filtration (e g the lining epithelium of the frog's lung, the membrane of Descemet covering the cornea. the lining epithelia of gland ducts and in all probability the outer wall of the glomerular capsule itself).

Again, the development of such special structures as encapsulated glomeruli merely to produce water and salts is so obviously superfluous when we remember that the lungs and skin, the salivary glands, the pancreas and the liver can all eliminate water (and the salts) in equal or greater quantities in the absence of these structures. If it be argued that the water is required to "flush" the tubules (5 or 6 cms. in length, 13) either by setting up a "pressure head" (11) or by acting as a pump, the needlessness of the glomeruli to effect this object is evident when we call to mind the facts that the semi-solid non-motile semen can travel down 50 cms. of a testis tubule, the narrow passage of the rete testis and some 600 cms. of coiled epididymis duct without any such aid, and that bile traverses channels fully as narrow as and much longer than those of the renal tubules in order to reach the gall bladder.

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[1] The one exception is the liver, and in this case the secretion is not derived from arterial blood under high pressure but from venous blood under low pressure, and, as in the kidney, the quantity of secretion is regulated by the blood supply.

[2] Exuded from the least permeable kind of capillaries (those of the limbs); in more permeable capillaries, from which lymph is exuded more abundantly, the contained percentage of proteids is from 4%—8%. Professor Bayliss has however referred me to the paper by Scott (Jour. Physiology Vol. 50, 1915, p. 157) in which it is concluded that fluid devoid of colloids, can re-enter the capillaries from the tissues and it would therefore appear to be possible for fluid, devoid of colloids, to leave the capillaries.

Finally, there is the possibility of alternative explanations of the raison d'être of the encapsulated glomerulus, and if there be any evidence in support of these, then, in view of the objections to the current explanations and indeed their final disproof, there is good reason for accepting any one or more of them as working hypotheses. I propose to offer three explanations, each non-contradictory of and to some extent supplementary to the others, for which I think there is much to be said. The first explanation is based on the fact that most or all thin-walled capillaries exude lymph and since the glomerular capillaries are known to be "extremely thin" and the blood pressure in them is higher than usual, there is some reason to suppose that they exude lymph or would if they could, despite the absence of a "chemical" factor. Now if the glomeruli merely lay between the tubules, adjacent to but not in contact with them, this lymph would freely escape from the glomeruli into the intertubular spaces in such quantity as to lead to an enormous excessive production of urine and so to defeat the main purpose of the glomeruli, which, as we have seen, is to limit the output of water and salt while ensuring the due elimination of nitrogenous matter. To obviate this escape of lymph, the glomeruli become encapsulated, or, in other words, completely surrounded by a thin non-permeable [1] portion of the tubule wall which effectually returns the exuded lymph to the glomerular capillaries (or rather prevents its exudation) and so maintains the distended condition of the tubular capillaries which is so essential to secretion. The inner capsule wall, according to this view, is then for the purpose of preventing that very exudation a peculiar form of which many physiologists assume to occur-[2]

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[1] If it be urged that it is difficult to imagine one part of the tubule wall being impermeable while the remainder is remarkable for its permeability, the analogous case of the physoclist gas bladder may be adduced, in which, while the greater portion of the lining epithelium is quite impermeable to the contained gases, the small area of the "oval freely permits the oxygen to pass through into the blood.

[2] I have not yet had an opportunity of meeting with a detailed description of the exact way in which the encapsulated glomerulus is supposed to "filter." To me it is difficult to imagine that filtration only

If, as I hold, the glomerulus does not part with water, and if the glomerulur capillaries are permeable to lymph, the formation of a capsule of some kind might be logically deduced.

The second explanation is founded upon the possible necessity for an automatic control of the amount of urine secreted by the kidney. When an animal becomes active not only is the arterial pressure raised but the percentage of nitrogenous waste matter (diuretic) in the blood is increased. The latter change widens the calibre of both the glomerular and the intertubular capillaries and the former ensures a more than sufficient supply of additional blood not only to fill these enlarged capillaries but to maintain a rapid rate of flow through them. The result of this enormously increased supply of blood through the widened glomeruli, together with the direct stimulation of the tubule cells by the added nitrogenous matter (urea, etc.), is to provoke the kidney to such a rapid output of urine that if this were allowed to continue, the body might soon become unduly depleted of water, salt and other useful substances. This will be more easily realized when it is remembered that high blood pressure from the standpoint of economical excretion, is a most unfavourable condition, since it involves an excessive loss of water and salt, which are the substances most necessary to be conserved, and a deficient elimination of the substances (e.g. urea) which most require to be eliminated (Appendix G, Part III). It is therefore evident that it may be necessary for the kidney to possess, on behalf of the organism, an automatic mechanism for regulating the kidney blood supply and thus preventing excessive activity on the part of the tubules.[1] This, it may be argued, is provided by the branch to the kidney from the splanchnic nerve, which, on stimulation, effectively contracts the kidney capillaries and therefore stops secretion. But it is possible that this means

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occurs at those few points where the superficies of the capillary mass of the glomerulus comes into contact with the inner capsule wall investing them, even though the latter is said to be "especially thin" at these points of contact, since it would imply that about 90% or more of the surface of the glomerular capillaries takes no part in filtration. On the other hand, if it be assumed that the capillaries exude lymph into the intercapillary spaces of the glomerulus and that the inner capsule membrane lets the water and salts through while retaining the colloids, it is not easy to understand how it is that all the intercapillary spaces do not quickly become permanently clogged with colloid matter which is unable to return to the capillaries. The only way out of the difficulty is to assume that colloid matter does not leave the capillaries (see footnote 2 on p 59)

[1] In other words, just as the tissues are relieved from receiving an excessive supply of food material after a meal (intermittent activity of the gut) by the mediation of the liver, so under certain conditions they may also require to be relieved from deprivation at an excessive rate not only of their waste matter (which after all attracts the lymph with food and oxygen) but of other substances useful to them by the mediation of some other organ.

may not serve for *moderate* control of the excretion, since, as is well known, the kidney can function efficiently when all its nerve connections are severed; moreover, it is equally well known that only strong stimulation of the splanchnic contracts the renal capillaries and this by abolishing or seriously diminishing the excretion would not remedy matters; on the other hand, weak stimulation allows the few dilator fibres to have effect and this would still further increase the output of urine. I suggest that the encapsulation of the glomeruli is the automatic mechanism required under the circumstances. The greatly increased blood supply awakens the activity of the tubules which swell out owing to the large quantity of urine contained by them. This large quantity of urine is produced at a greater rate than that at which it can escape and the consequence is that the secretion pressure increases and ultimately exceeds the blood pressure in the glomerular capillaries, the urine in the tubule lumina in consequence being forced into the capsule cavities and compressing the glomeruli.[1] The compression of the glomeruli of course, results in a diminution of the blood flow through their capillaries and there is by this means an automatic regulation of the blood supply in relation to the secretion pressure—the latter can never much exceed the former because the act of doing so reduces the latter by diminishing the blood supply.[2] In short this conceivable rôle of the encapsulated glomeruli somewhat resembles the regulation of temperature employed in connection with embedding baths and incubators—the temperature (= urine) becomes excessive, expands the mercury (= urine in the capsule) and the expansion of the mercury diminishes the temperature by cutting down the gas supply (= blood).

There is some evidence that this suggested rôle of the encapsulated glomerule occurs in actuality. In the experiments referred to on p 5 . in which I first perfused saline plus urea via the renal arteries in the frog and obtained a profuse secretion and then filled the perfusion bottle with chromic acid fixative. so fixing the tissues of the kidney in the act of vigorous secretion, I found, on subsequently macerating and teasing up the kidney (in Marcacci's fluid = equal parts of nitric acid, glycerine and water) that *in all cases the glomeruli completely filled the capsules.* On the other hand. when I repeated the experiment with reverse current (i.e via the post-caval, with ligatured renal afferent veins, the fluid making its exit via the cut renal arteries) and the urine output was as usual several times greater than with the direct current, I found that the glomeruli were very much contracted—a large space separating the inner and outer capsule walls.[1] These results show that when the pressure of the urine in the tubules exceeds a certain value, the urine becomes forced back into the capsule and the glomerulus becomes contracted.[2]

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[1] As Brodie(11) says, "A pressure within Bowman's capsule greater than the blood pressure would at once lead to the closure of the glomerular loops and arrest of the circulation." The expansion of the tubules will first compress the adjacent intertubular capillaries and therefore cause the glomeruli to swell, but the limit to the distension of the tubules is soon reached and consequently to the compression of the tubular capillaries and when this limit is passed, the urine forced into the capsules will compress more effectively the glomeruli, since, as shown in cases of nephritis and by the experiments of Brodie and Mackenzie (13), there is no limit to the compression of the glomeruli when the output of the urine is impeded.

[2] I have no doubt but that this idea of automatic control of urine output has been suggested before—as the following quotation suggests—but being in India I am unable to ascertain for certain. "In other cases, such as the kidney, where the secretion pressure cannot be raised above arterial pressure, this is due to the nature of the minute anatomical structure, as a result of which all supply of fluid is cut off from the secreting cells before [when] the pressure in the ductules can exceed that in the blood-vessels, and so the stoppage of secretion is a purely mechanical effect" Benjamin Moore (24, p. 143).

Brodie and Mackenzie (13) come to the couclusion that whenever a kidney is active, a space always exists between the inner and outer capsule walls, representing, in their opinion, the urine which is being exuded from the glomerulus, but this space, observed by these authors, is due either (*a*) to differential contraction of the spongy glomerulus away from the more substantial surrounding tissues which occurs when the kidney is passed through alcohol and clearing reagents and later exposed to the heat of an embedding bath (I found by experiment that this was the case in my chromic acid experiments) or (*b*) it is due to the fact that these authors "were never able to keep the blood in a kidney that was excised at the height of activity. At the instant of excision such a kidney is hard and tense, and Instantly becomes soft when the first ligature is tied round the pedicle. This is even the case though the vein be first ligatured...... Even then there is a distinct escape of blood through the Capsule [enclosing the whole kidney] and the cortex rapidly pales in colour as the tension falls." In other words, at excision, while urine secretion by the tubules continues, the blood pressure inside the kidney falls and the urine secretion pressure automatically becoming greater than the reduced blood pressure, the urine is naturally forced back into the capsule.[3] The intracapsular space observed by Brodie and Mackenzie was probably due to both of these causes combined. My experiments, on the other hand, were free from both these defects. The method I adopted for fixing the active kidney avoided a fall in blood pressure, and the maceration method avoided differential tissue contraction due to alcohol and the heat of embedding.[1] Thus Brodie and Mackenzie's statement that in the active kidney "a considerable accumulation of secretion" is found between the inner and outer capsule walls is erroneous and devoid of all value as an argument for production of urine from the glomeruli. I may add that my interpretation of the results of Brodie and Mackenzie is also the interpretation to be placed upon the statements so often made that when albumen, haemoglobin and carmine are injected into the blood, these substances are to be found in the capsules of the excised kidneys[2]—statements which are advanced as evidence of these and other substances having been filtered through the capsules from the glomeruli. It is certain that the blood pressure in the glomeruli is much higher than that in any of the other kidney vessels and it is also certain that the only other pressure which can counteract and regulate it is the secretion pressure of the urine produced, whence it is obvious that if the glomerular blood pressure is to be controlled the glomerulus must be available for the urine pressure to act upon, i.e. the glomerulus must be either inside the tubule or enclosed in a closed space communicating with the tubule. A similar condition is demanded by the pump theory. If the glomerulus or glomus contracts previous to each heart beat, then, in order to act as a pump, urine must immediately flow into the capsule or other cavity from the tubule and the secretion pressure in the tubule being temporarily lowered by the capsular inflow, more urine must be formed in the tubule; when the glomerulus expands it will expel the urine which has entered the capsule or other cavity and this will aid in the expulsion from the tubule of the urine more recently formed. The pump theory therefore demands a residual amount of urine which flows to and from the capsule[3] and which is only used in expelling urine more recently secreted.

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[1] The condition of the glomeruli in this latter experiment also shows that the swelled condition of the glomeruli of the first experiment was not due to the macerating fluid, as my friend Mr. R. H. Whitehouse suggested.

[2] The contraction of the glomeruli in these reverse current experiments probably also in part explains why only a proportion of the perfusing fluid made its exit from the renal artery or arteries and not the whole.

[3] Brodie (11, p. 581) admits the possiblity of this explanation and in-

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deed both authors (13) furnish evidence of its probability when they state that the capsules (and tubules) of an active obstructed (ureter constricted) kidney are more distended with accumulated fluid than those of an active unobstructed kidney (the letters R and L should I believe be transposed at the head of the measurements supplied by these authors).

[1] Brodie and Mackenzie state that in the inactive kidney "the glomerular surface always lies in contact with the capsule wall"—the explanation of which is that the glomerulus and capsule are already so shrunken that heat and alcohol have not much power to produce differential shrinkage.

[2] Warrington Yorke (48) has adduced strong evidence in favour of the view that free haemoglobin in the blood is not excreted from the capsules.

[3] Another possible explanation of the encapsulation of the glomeruli is that it is for the purpose of enabling the glomeruli to contract and ex-

Personally I do not accept the pump theory for reasons already stated, (absence of suitable pulsation, no necessity, no evidence for intracapsular space).

The third and last explanation of the Encapsulation of the glomeruli is based upon the fact that all organs developed at the sides of the vertebral column, between this, the stout peritoneum and the powerful myotomes, are subjected to considerable constant and intermittent pressures, due both to the small amount of available space and to the contractions of the myotomes involved in locomotion. It is to escape these pressures, or at least the intermittent ones, that the primitively paired lateral aortae and posterior cardinal veins become median and single (aorta and post-caval—43) and that the gonads and kidneys (and to a less extent the blood vessels and ducts) project more and more into the coelom the higher the type of organism. Now each tubule of the kidney is morphologically a separate segmental organ (well seen in the Myxinoids and in most Vertebrate embryos) and this is developed from the coelom in the dense connective tissue in the situation just described. Each such tubule is primitively supplied by a distinct arterial twig direct from the aorta and it is evident that if, under the limited space conditions stated, this twig is to develop an enlargement (the glomerulus) in its course, it will be most easy to do so in the proximity of a space filled with a fluid under relatively low pressure and bounded by an easily invaginable thin wall (cf. the formation of the “renal portal” system, in which, under the same conditions, the kidney tubules invaginate the wall of a venous sinus) than in any other position. Such a space is provided by the at-first thin-walled tubule [1] both in the most primitive fishes and in the highest mammals. It is evident that the kidney tubules need to be kept under constant pressure (as is shown by the development of the Capsule enveloping the entire organ when this projects into the coelom in higher Vertebrates) in order that they may

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pand without interfering with pressures in the other parts of the kidney. If the space between the inner and outer capsule walls of each glomerulus were a vacuum, then at each contraction of the 2,000,000 odd glomeruli of the human kidney, e.g. 2,000,000 capsules would contract, and this change of volume of the capsules could not occur without causing considerable perturbations of flow and pressure in the capillaries and tubules composing the rest of the kidney, since the whole substance of the kidney is contained under pressure by the kidney capsule. On the other hand, if contraction and expansion of the numerous glomeruli merely involves a slight to and fro movement of a small amount of urine, the capsules remaining constant in size, the perturbations referred to would be avoided.

[1] The glomeruli do not always protrude into the extremities of the tubules, e.g. in forms with nephrostomes the capsules are sometimes a considerable distance from the end of the tubule and in the lamprey and in some snakes (Tropidonotus, Vipera) the tubules or branches of them end blindly some distance beyond the capsules (34). In Amphioxus the glomerulus is represented by a small reticulation of the artery lying above and not in contact with the nephridium.

not expand unduly and secrete too vigorously, and I suggest that it is this pressure which has led mechanically to the encapsulation of the glomeruli and so provided the kidney not only with an additional means of limiting the output of urine but also a means of avoiding all possibility of extravasation through the thin walls of the glomerular capillaries. The protruding of "external glomeruli," and glomi in some Fishes and Amphibia into the coelomic cavity instead of into the tubules is but an additional illustration of the pressure I have predicated. The encapsulation of the glomeruli then may be regarded as but one of several of the results due to the development of the kidney in a confined space under intense pressure, and may therefore be a purely mechanical product initially devoid of any physiological significance.

I have in the preceding paragraphs suggested at least three explanations regarding the origin of the encapsulated glomerulus. all of which are possible in the present state of our knowledge and perhaps probable and are at least free from the objections which apply to the current hypotheses of glomerular filtration or secretion.

A Consideration of some other Arguments used in support of the neo-Ludwig Theory.

We will first consider as briefly as possible the arguments advanced by Cushny (17) for the purpose of showing that the kidney is distinguished from all other glands by certain morphological and physiological characters—the object of laying emphasis upon these supposed fundamental differences being to secure a permit, so to speak, for the interpretation of kidney activity on lines different from those adopted for other glands. I have already stated my belief that the glomerulus is merely the physiological equivalent adopted by the kidney of the length of artery which separates all other glands from the dorsal aorta, and I have implied that the encapsulation of the glomerulus is possibly the equivalent of the nervous control which regulates the activities of these other glands. The reason for the substitution of both these equivalents is the necessity for the kidney (1) of a large supply of blood at a relatively low pressure and rate of flow and (2) a capacity to respond to changes in the blood, both of quantity and quality, for the benefit of the organism as a whole, and it can best comply with both these necessities by being situated near the aorta and developing a device to reduce the pressure and rate of flow, and by in large part reacting to the blood as a conveyor of messages from the organism instead of depending on messages conveyed by nerves (in which respect it resembles the liver!); other glands, on the other hand, have to react to changes occurring in other parts of the body not in contact with them (salivary and pancreatic glands e.g.) and even to changes in a part separated from the body (e.g the activity of the mammary glands is co-ordinated with the requirements of the infant) and such rapport can only be established by means of nerve control, the blood supply in these cases chiefly serving as a supply of nutrition. It appears to be necessary to state these obvious elementary facts because Cushny implies that because the kidney in the main devotes itself to abstracting already-formed substances from the blood, i.e. to performing the function for which it was developed, instead of manufacturing specific secretions (not required by the body) it is therefore the more probable that its gland cells should differ from those of most other glands in their mode of function, but it is notoriously not true that the kidney totally differs from other glands in this respect, since we know that all glands do secrete with or without change of concentration many substances already contained in the blood and that the kidney is known to manufacture at least one substance.

Further other glands do exist which, like the kidney, are solely concerned with abstracting substances already present in the blood and manufacture nothing on their own account. The ordinary walls of the blood vessels and the cells of ordinary tissues can allow oxygen to *diffuse* through them from the blood, but when it is necessary to *concentrate* this oxygen before passing it into an adjacent space, a typical gland is developed, as in the oxygen gland associated with the gas bladder of teleost fishes.[1] Again, ordinary squamous cells can allow calcium and other salts to diffuse through them, but when it is necessary to *concentrate* these salts to form a skeleton, typical gland cells are again developed, as the odontoblasts and osteoblasts or the spicule-forming cells of sponges and other organisms. And, even on Cushny's hypothesis, the tubule cells of the kidney (and the villus epithelium of the gut) assume a glandular form though they are solely concerned in merely passing through substances presented to and not manufactured by them. If it be a general rule that a gland is developed when, apart from the manufacture of special substances, it is necessary to concentrate or otherwise alter the composition of in-coming substances, then the kidney is not an isolated exception but is, on the contrary, an excellent example of conformity to rule, and the only exception to this rule would be the renal tubule epithelium if, as Cushny assumes, it absorbs unchanged the Locke's fluid portion of the glomerular filtrate. We further object to the additional supposition—advanced with the same object in view—that because the gland cells of the kidney differ from all other gland cells in being developed in the walls of mesodermal coelomic tubules, there is therefore still more reason for assuming that their mode of function differs from that of other gland cells. So far as I know gland cells can if required be developed in any duct, passage or position in any germ-layer of the body—in the brain ventricles and buccal cavity (ectodermal), in the gut and its outgrowths (endodermal), in the genital ducts, urethra, supra-renal bodies, and on blood-vessels (mesodermal)—and I am not aware that difference of locality of development has in any of these cases ever previously been advanced as a reason for assuming that their modes of producing secretions must therefore differ in principle. The kidney again is said to differ from all other glands in its capacity of concentration of some of the substances abstracted from the blood, but this again is what it should do from the very nature of its function, since the water which leaves the ureter is lost to the organism and is not reabsorbed like the water of bile, saliva, gastric or pancreatic juice; and moreover it is only a difference of degree since if the kidney can concentrate urea and sulphates 60 times (or even urea 150 times as in the cat), the oxygen gland of the gas bladder of many teleost fishes can secrete from the blood a bladder full of almost pure oxygen (95%) under a pressure of forty or more atmospheres, the cells of siliceous sponges can secrete a solid siliceous skeleton from sea-water containing 1 part of silica in 100,000 parts of water, the udder of the milch cow can concentrate lime 9·4 times, the salivary glands of *Dolium galea* can secrete 5% sulphuric acid, the gastric glands secrete HCl of deci-normal strength, and so forth. Again the kidney (17, p. 110) is said to differ from typical glands in the fact that its maximum secretion pressure lies from 40—60 mm. (Hg) below that in the aorta, whereas the secretion pressure in the submaxillary duct exceeds that in the arteries; nevertheless secretion from the pancreas ceases when it attains a pressure of 21 mm. and this, like that of the kidney, lies far below that at which the arterial blood circulates in the gland arteries. Moreover, if the glomerulus is after all only a rete, the chief purpose of which is to reduce the blood pressure, then the blood pressure with which the secretion pressure should be compared is not that in the aorta or renal artery but that in the efferent glomerular and tubular capillaries, and the urine secretion pressure must easily be able to exceed this, otherwise the secreted urine would be unable to distend the tubules. In short all these supposed fundamental differences of origin and function which are said to distinguish the kidney gland cells from other gland cells as an excuse for interpreting the modus operandi of the former on a different principle from that of the latter are non-existent.

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[1] See the author's papers published in the Proc. Zool. Soc. London, 19'1, p. 183, and Anat. Anzeig. Bd. 40, 1911, p. 225.

I proceed to the consideration of some of the remaining pieces of evidence advanced in favour of the neo-Ludwig theory. The fact that during diuresis the urine comes to resemble more closely than normal urine the hypothetical glomerular filtrate, i e. contains a greater percentage of water and salt, is often advanced as an argument in favour of glomerular filtration, but since, as a perusal of the ordinary text-books will show (see footnote 1 on p. 54), many glands are known to secrete a greater proportion of water and salt and therefore a less proportion of solids when stimulated, this argument is not of much value. Nor is the other argument, advanced by Cushny (p. 96) that because the activity of the kidney (as measured by oxygen consumption) shows no signs of increase above the normal during diuresis due to injection of Ringer's fluid, though the output of urine is greatly increased therefore the energy expended in secreting this extra output of urine must be due, not to the activity of the kidney (tubule) cells but to an external source of energy, viz. the blood pressure in the glomerulus, of more value as evidence for glomerular filtration, since, as Cushny himself admits, the energy of the kidney is devoted to the concentration of the urine constituents and not to their mere passage into the lumen of the urinary tubules,[1] the latter process being possible even when the *tubule* epithelium is dead, as shown by the experiments with chromic and picric acids (see p. 51). All the facts in short point to the process being largely one of filtration under the conditions named, but it is filtration through the tubules, not the glomeruli, since no filtration occurred when the chromic and picric acids were perfused via the aorta.[2]

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[1] " The energy spent on excreting water must be very little, since neither the CO_2 output of a fasting cat was found increased by giving it much water, nor was the O_2 intake of a child influenced by an attack of diabetes insipidus during which she drank eight litres of water a day " (24, p. 262).

[2] The perfusion experiments of Miss Cullis (6.) on frogs are sometimes referred to as affording definite evidence of production of water by the glomeruli. Thus she states, " There is no doubt that under all ordinary conditions the water of the urine comes almost entirely from the glomerulus, the cessation of urinary flow on cutting off the glomerular circulating flow showing this quite conclusively. Apparently however, the tubules can secrete water under a sufficiently strong stimulus, as in the experiments with urea and phloridzin, where at times a considerable flow of urine was obtained on a venous perfusion only." Personally I should have thought that such a statement was evidence for tubule secretion, seeing that during both perfusions fluid traverses the intertubular capillaries and urine is produced, whereas the glomeruli are only traversed during the aortic perfusion. However the statement is not valid as evidence for the simple reason that the separateness of the renal venous meshwork from the intertubular plexus is not recognized, and further comment is unnecessary save for the remark that to me it is difficult to conceive how any stimulus can be " strong " enough to compel glands to make such a radical change in their mode of function as to give rise to different products. The results of the classical experiments of Nussbaum (30) obtained in living frogs are similarly useless as evidence for glomerular production of water and for the same reason. The arterial blood flowing

Finally, apart from it being an attempt to explain the encapsulation of the glomerulus, the neo-Ludwig theory is supposed to be superior to all rival theories in its simplicity. This simplicity is supposed to lie in the statement that if we assume glomerular filtration of the non-colloid portion of the blood and tubular absorption of Locke's fluid, a key is thereby provided for the interpretation of all the data of kidney activity. But, quite apart from the question as to whether this is so or not, it is evident that the supporters of this theory are, to begin with, running counter to all the rules of scientific methodology not only in setting out with the assumption of a process not known to occur in any other part of the Vertebrate body[1] but in likening a secretion-producing organ like the kidney to the absorptive portion of the gut in which the blood only receives rather than to the numerous other kinds of glands in which, as in the kidney, the blood chiefly relinquishes. I contend moreover that a theory which assumes that the kidney is an organ which devotes about 99% of its substance to returning to the blood $\frac{68}{70}$ths of what the 1% has abstracted from it is anything but simple. Cushny however argues (p. 53) that although for the daily excretion of 35 grams of urea the neo-Ludwig theory requires 70 litres of glomerular filtrate to be separated from the blood colloids and 68 of these to be re-absorbed through the tubule epithelium, yet the Bowman-Heidenham (Tubule cum Rete) theory likewise requires 70 litres of plasma to exude into the lymph spaces round the tubules (only 2 of which pass through the tubule epithelium) and 68 litres of these to be " re-absorbed " by the blood vessels, and therefore "the two rival theories ... ... both require about the same amount of fluid to come into contact with the epithelium" and therefore "the difficulty is almost equally great in accepting either theory"

But this is not a valid comparison between the requirements of the two theories, because, on the neo-Ludwig view, the 68 litres of non-colloid filtrate are supposed to be separated from the colloid part of the blood *by the whole thickness of the wall of the tubule,* whereas, on the Tubule cum Rete theory, the 68 litres would only be supposed to be separated in the

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in the renal arteries traverses the tubule sinusoids as well as the glomeruli, and since we now know that the venous blood does not supply the tubules, either of these structures may have supplied the water: the argument for glomerular secretion or filtration is therefore worthless.

[1] It can be safely asserted that no organ of absorption is known which absorbs fluid always of the same composition whatever changes may occur in the quality of the fluid in contact with it, not to mention those of the blood which traverses its blood vessels. It is quite evident that, despite Cushny's comparisons between the two, there can be no real likeness whatever between the functions of the villus epithelium and that of the kidney tubule.

sense that lymph is separated from the blood in all other glands [1] – the term "re-absorption" has not the same meaning in the two cases. On the Tubule cum Rete theory, there is no more re-absorption in the kidney (in the neo-Ludwig sense) than there is in the salivary gland. Further we may well enquire from supporters of the neo-Ludwig view in what way they suppose glomerular filtration and tubule absorption *per se* to be superior to the more simple, or at least more usual, process found in all other glands? Nobody will deny that glands in general can (and do) abstract as much water and crystalloid substance from the blood as the kidney does, or that the ordinary type of gland could, if the organism required it, concentrate urea, sulphate and other substances to the required degrees by the usual process (and even on the neo-Ludwig view it is the glandular tubules which effect this concentration—not the capsules or glomeruli) All that such an ordinary gland would require would be an abundant blood supply, i.e. it would have to be situated near the aorta, and some device for protecting it against excessive pressure and rate of flow. But the Vertebrate kidney exactly answers to these requirements in both particulars.

Cushny again contends that "the Bowman-Heidenhain theory [and therefore the Tubule cum Rete theory]... amounts to little more than the statement that the kidney secretes the urine by the vital activity of its cells" —and is therefore "a nebulous statement of the renal function," but the same may be said of any existing theory of secretion applied to the salivary, pancreatic or other gland. Further, if this statement "as a defensive position... is impregnable" in virtue of its "nebulosity," the same may equally be said of a large part of Cushny's defence of the neo-Ludwig theory. For example on page 41 it is stated as a "grave objection" to the Bowman theory that it "endows the renal cell with powers of discrimination of a very high order" being "capable of detecting, and is aroused to activity by, quantitative aberrations in the composition of the blood," and that (p. 56) "the modern [neo-Ludwig] view dispenses with the power of the kidney to discriminate between minute changes in the composition of the blood, and this renders it superior to the rival view of specific secretion," whereas on page 144 it is argued, on neo-Ludwig lines, that the inability to detect dilution of the blood by ordinary methods of blood examination "merely demonstrates *the extreme sensitiveness of the kidney (and the epithelium of the tubules in particular) to changes in the concentration*"[1] of the blood !! Again (p. 48) "the absorption [by the tubules] of the optimal fluid [Locke's fluid] is due to *unknown forces*."[1] Again, when the question is raised as to why, on the absorption hypothesis, tubule cells should absorb a useless pigment, the reply is (p. 64) that these cells "*are no longer quite normal at this stage*"[1]—a mode of defence which amply justifies Starling's criticism that the neo-Ludwig explanation of the presence of dye in the kidney cells is "somewhat forced" (40, p. 1282). Again, when masses of secretion are found in the lumen of portions of tubules devoid of glomeruli (in the lamprey and snakes), it is replied (p 68) that the argument is unconvincing because these kidneys are of a "lower type" as compared with the mammal kidney, though identical in general plan of construction, and all results of perfusion experiments on the frog's kidney are objected to (p 83) on the ground that "the frog's kidney is a very small object, and there is no security that a fluid perfused through one part of it may not perfuse into other structures" (though I doubt if such a remark would have been made anent perfusion experiments on the kidneys of a mouse), that the frog's kidney is not a mammal kidney (though identical in construction) and that "a perfused kidney is constantly in a state of partial asphyxia and cannot be regarded as in any way capable of such activity as the normal organ" (though the results of numerous perfusion experiments exactly corroborate those obtained from experiments on the blood-perfused kidneys of living animals). "In perfusion of the mammalian kidney for example ...... the capacity of secreting urine is lost almost instantaneously after excision, though filtration still continues possible." This last statement is not at all intelligible. If it be meant that the mere act of excision disqualifies a kidney from ever again secreting urine, I need only refer to Cushny's own quotations (pp. 13, 14) of experiments in which mammalian kidneys have not only been excised but also grafted in different positions and in different animals, and in all cases the kidneys worked as well as before. If, on the other hand, it be meant that the fluid usually called "urine" is not secreted when the kidneys are perfused with Ringer's or other solutions, I may say that no one acquainted with the facts would expect the fluid normally excreted from blood to be excreted from another fluid largely differing in composition from blood. Whatever the fluid formed by the kidney it is excreted by the kidney from the fluid in the intertubular vessels and if by "urine" we mean fluid formed by the kidney, then the secretion of perfusion experiments is as much "urine" as that micturated by the living animal. If, on the other hand, we restrict the term "urine" to that which is micturated, then neither can the term "filtrate" be generally applied to the fluid secreted in perfusion experiments for the simple reason that only very rarely is the "filtrate" isotonic with the perfusing fluid, and then it is due to the same conditions which cause the living animal to secrete what is practically Ringer's fluid after a copious injection of it into the blood.

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[1] See the excellent account by Benjamin Moore (24) of what may be called the "electrode" theory of secretion and absorption—a theory which largely obviates the assumed transmission of vast quantities of water to and from the lymph for the conveyance of sufficient quantities of substances to be excreted or absorbed. I am not aware that large quantities of water are assumed to be absorbed and eliminated in the absorption of oxygen from sea and fresh-water by the external gills of Fishes and Urodeles, nor from the blood by the oxygen gland of the bladder of many teleost fishes, and I do not understand why it should be assumed that the kidney should need to adopt what Starling rightly calls such "a clumsy way of arriving at a urine, whose comosition should be adapted to the needs of the animal" (40 p. 1288). When it is realized what gland cells can do in extracting substances from the blood, in concentraing them and in manufacturing new substances all precisely adapted to the requirements of the body as a whole, the idea that in the case of the kidney the blood should have to exude the fluid part of its substance into a space continuous with the outside world and that a special gland should have to be developed to catch as much of this exuded fluid as is of value to the body as the rate of escape of the fluid allows, appears grotesque to say the least.

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[1] My italics.

But I have quoted sufficiently to prove that the neo-Ludwig mode of interpretation is fully as elastic as the theory which it proposes to supplant. I will only add that if the renal function could be fully explained on quasi-physical lines, it would, so far from assisting us to understand the mechanism of secretion in general and of the organism as a whole, only place one more difficulty in the way by adding the problem as to why such an unique organ as the kidney should exist.

Summary of some of the Principal Conclusions contained in Parts I–IV.

All true, i.e. functional, portal systems are known to be developed by activity of the vascular tissue; on the other hand, the "renal portal" system is solely due to the encroachment on and mechanical subdivision of the posterior cardinal or other adjacent vein by the developing kidney tubules. and on this ground alone, cannot be regarded as a true portal system (Part I). Other a priori arguments against the idea that the "renal portal" system is functional are summarized in Part I.

Frogs and toads can live as well without as with a venous supply to the kidneys, provided that other conditions remain the same (Part II), and the kidneys of frogs deprived of the venous supply can, also provided that other conditions remain the same, excrete urine equal in quantity and strength (nitrogen and chloride) to that excreted by normal frog kidneys (Part III). These results are confirmed by perfusion experiments (Part II).

Gurwitsch is mistaken when he asserts that in a frog the kidney deprived of its venous supply excretes less urine than the "normal" comparison kidney; as a matter of fact, the vein-deprived kidney excretes more urine because the "normal" kidney is hindered by diminished flow in its arterial capillaries due to increased pressure in its renal afferent vein. This same increase of pressure (due to congestion of blood consequent upon the ligature of the corresponding vein of the vein-deprived kidney) also accounts for the superior nitrogen and chloride strengths of the normal kidney urine (Part III), the former being due to actual penetration of the venous blood (with its greater percentage of nitrogen) into the arterial capillaries (intertubular plexus), the latter to the increased pressure alone (see Appendix G, Part III). Increased capillary pressure by itself leads to nitrogen-weakening of the urine (Appendix G) and this occurs if the fluid in the renal afferent vein is of the same nitrogen strength as the arterial fluid, but the nitrogen-weakening in these experiments is obscured by the strengthening of the arterial blood due to slight admixture with the nitrogen-stronger venous blood.

The perfusion and dye-injection experiments of previous investigators have failed to detect the essential fact that the coarse vascular network formed by each renal afferent vein in the kidney (renal venous meshwork) is distinct and separate from the network of much finer arterial channels known as the intertubular plexus, owing to the non-employment of correct relative rates of flow of the fluids in the renal arteries and renal afferent veins respectively (Part I). The non-recognition of this fact has not only led to wrong individual conclusions but has greatly confused the discussion concerning the respective functions of the tubules and the encapsulated glomeruli.

The results of many perfusion experiments confirm and extend the results of experiments performed on the kidneys of the living animal which indicate that the glomeruli neither filter nor secrete water or any other substances, all constituents of the urine being eliminated by the kidney tubules. The facts which definitely prove that the glomerulus does not produce water are, briefly stated : (1) rate of output of urine is proportional to the volume and rate of flow of the blood or other perfusing fluid in the intertubular plexus capillaries and bears no relation to pressure in the glomerulus, save in so far as this is a cause of flow. This fact by itself is fatal to the view of glomerular filtration; (2) when the fluid perfusing the kidney is reversed (the vein being afferent and the artery efferent) then, although pressure in the glomeruli is reduced, the output of urine is enormously increased, which again is definite proof that the tubules secrete the urine and not the glomeruli; (3) a reversed perfusion current through the dead (fixed) kidney shows that when filtration does occur, the filtrate is from the tubules and not from the glomeruli; (4) increase of pressure in either the renal artery or the efferent vein produces urine stronger in chloride and weaker in nitrogen: since increase of pressure in the post-caval should, on the neo-Ludwig view, produce urine weak in chloride and strong in nitrogen (both because the intertubular plexus capillaries are better filled than usual and therefore favour absorption and because the glomerular filtrate is diminished in quantity), this fact is also fatal to the ideas of glomerular filtration and tubule absorption ; (5) the fact already referred to in this Summary that in the " portal " kidney a very slight increase of pressure in the renal afferent vein *increases* the nitrogen strength of the urine is proof that the tubules are secreting the urine, because under the conditions such pressure increase could not possibly force venous blood into the glomeruli (the arterial circulation remaining in full force) ; (6) allowing for the nature of its rôle in the bodily economy, the kidney functions in the same way as all other glands, and there is no justification for the grotesque idea that the kidney glomerulus filters the non-colloids from the blood into a space continuous with the outside world (a supposition without analogy in any other part of the body in any organism) and that a special gland is developed in the walls of the tubule to catch as much of this filtrate as is of use to the body as the rate of escape of the filtrate allows. The glomeruli are simply retia mirabilia, the functions of which are (like those of the great length of artery which separates all other glands from the aorta) to reduce the blood pressure (since high pressure lowers the output of nitrogen and raises the output of chloride, and this is the reverse of the result required by the body), to retard the rate of flow of the blood (since excessive flow involves excessive urine output) and to eliminate the heart beat, and which at the same time allow the kidney to be supplied with a volume of blood which, relative to the mass of the kidney, is probably larger than that supplied to any other organ in the body—a supply which it owes to the large calibre of the renal artery and its proximity to the aorta.

The enclosure of the glomerulus by a portion of the tubule wall to form the capsule by no means necessarily implies the exudation of water and dissolved substances from the glomerulus into the tubule lumen, and it is more than likely that the capsule is formed for the very purpose of preventing the exudation of lymph which might well occur if the glomerulus were naked. I have suggested two other purposes which are possibly served by, and a proximate cause of, the encapsulation of the glomerulus.

APPENDIX A.

On the Rates of Flow of Fluid through the Renal Arteries, the two Renal Afferent Veins, the Dorsal Aorta and the Anterior Abdominal Vein in Rana tigrina.

The frog in each of the five experiments conducted to ascertain the facts indicated by the above title was as usual prepared in a manner similiar to that described in Appendix F, Part III. A large-bore cannula was tied on the left side of the body into the coeliaco-mesenteric artery and the fluid was perfused at 24 cms. pressure; a similar cannula was tied on the right side of the body into the post-caval, the free end of the cannula being fitted with a piece of rubber tubing which, lying on the dissecting board, allowed the escaping fluid to flow into a beaker at the same level as the post-caval. Both systemics were of course ligatured and cut anterior to the ligature, and great care was taken that no branches of the iliac arteries or renal afferent veins were cut. No part of the gut or ventral body-wall, nor the gonads or fat-bodies were removed, hence cut portal vein, anterior abdominal vein or other factors were not available as avenues of escape for the fluid. The ureters were cut off close to the kidneys so that excretion might have free outflow.

EXPERIMENT 1. 0·6% saline (made with tap water) was the perfusing fluid. Experiment set going at 9·40. Between 10 0 and 10·15 the aortic flow (A.f.) was 271 c.c., and the outflow during the same period from the post-caval cannula (P.C.f.) was 125 c.c., which means that 146 c.c. escaped via the cut systemic arteries and cut capillaries. The nozzle of the post-caval cannula must be kept from contact with the walls of the vein.

First Phase : r.a.v. open.	10·20–10·35	10·40–10·55	11·0–11·15
	A.f.=202 c.c. P.C.f.=130 c.c.	A.f.=176 c.c. P.C.f.=135 c.c.	A.f.=175 c.c. P.C.F.=134 c.c.

At 11·15 I ligatured both the r.a.v. and cut both veins posterior to the ligatures. Both r.a.v. anterior to the ligatures became very small, but later filled out.

Second Phase : r.a.v. shut.	11·20–11·35	11·40–11·55	12·0–12·15	
	A.f.=174 c.c P.C.f.=20 c.c.	A.f.=174 c.c. P.C.f.=22 c.c.	A.f.=175 c.c. P.C.f.=24 c.c.	
	12·20–12·35	12·40–12·55	1·0–1·15	
	A.f.=177 c.c. P.C.f.=28 c.c.	A.f.=173 c.c. P.C.f.=32 c.c.	A.f.=168 c.c. P.C.f.=35 c.c.	(r.a.v. now half-filled)
	1·20–1·35	1·40–1·55	2·0–2·15	
	A.f.=163 c.c. P.C.f.=35 c.c.	A.f.=161 c.c. P.C.f.=33 c.c.	A.f.=161 c.c. P.C.f.=31 c.c.	

Since in comparing the flows of the two phases of the experiment it is desirable to select for comparison the flows during those periods in which the aortic flows were as nearly as possible identical, we will select the flows of the last two periods of the first phase and compare with them the flows of the 4th, 5th and 6th periods of the second phase, since in these last three periods the average aortic flow is nearly identical with that of the two selected periods of the first phase, and moreover, the post-caval flow in these three periods of the second phase attains its maximum—in other words, the fluid supplied by the renal arteries has penetrated into the empty channels of the "renal portal" system as much as it ever will do, and therefore, in these three periods, the post-caval flow represents the full outflow from the renal arteries, no fluid being retained in order to fill out further the empty renal venous meshwork.

Now the average flows of the two periods of the first phase are:—

average aortic flow = 175 c.c. in 15 minutes
average post-caval flow = 134 c.c. in 15 minutes

and of the second phase:—

average aortic flow = 173 c.c. in 15 minutes
average post-caval flow = 32 c.c in 15 minutes

from which we may conclude (1) that of the 134 c.c. which escape via the post caval in the first phase, approximately 32 c.c. are supplied by the renal arteries, and the remainder, viz. 102 c c., by the two r.a.v., i.e. *the combined flows in the two r.a.v. are approximately* 3·2 *times the flow in the renal arteries, i e. the venous supply to the frog kidney is approximately* 3·2 *times as great as the arterial supply ;* (2) *that the flow in the aorta is approximately 3·4 times* ($\frac{175}{102 \times 1/2}$) *the flow in each r a.v. ;* (3) *that the flow in the renal arteries is approximately* ($\frac{174}{32}$) 1/5 *of the total flow in the aorta*, and (4) that the flow in the anterior abdominal vein is approximately $\frac{41}{51}$ times that in each r.a.v.

I performed four other experiments similar to the above which, to economize space, I will not record in detail. These only differed in the bore of the cannula used, in human urine being added to the perfusing saline or in the heart being cut out.

On comparing the results of these five experiments, I found that, as regards the volume of the venous supply to the kidney relative to the volume of the arterial supply, Experiment 1 gave the former as being 3 2 times greater than the latter, and in the other four experiments, 2·5 times, 3 times, 3 times, and 5 times respectively from which we may conclude that *the venous supply to the frog's kidney is normally at least* 3 *times as great as the arterial supply.*

As regards the volume of flow in the dorsal aorta relative to the volume of flow in each renal afferent vein—an important subject in connection with the conduct of perfusion experiments—Experiment 1 gave the former as being 3·4 times as great as the latter, and the other four experiments 2·5 times, 4 times and 3·8 times (Exp. 3 was untrustworthy owing to undoubted aortic leakage), the average of these values being 3·4. Hence *the rate of flow in each renal afferent vein in a perfusion experiment should be at least* 1/3, *and, to ensure the absence of excess of pressure, preferably* 1/4 *of the rate of flow in the aorta.*

From the results of three of the experiments we may also state that 1/5–1/6 of the total blood in the aorta is passed through the kidneys (the result of Exp. 3 in this connection was unreliable and the value of 1/10 of Exp. 5 is too aberrant to be considered).

Finally these perfusion experiments (excluding Exp. 3) state respectively that the flow in the anterior abdominal vein is $\frac{41}{51}$, $\frac{66}{35}$, $\frac{88\cdot5}{63}$, and $\frac{88}{62}$ times that in each of the renal afferent veins, or $\frac{0\cdot9}{1}$, $\frac{1\cdot8}{1}$, $\frac{1\cdot4}{1}$, and $\frac{1\cdot4}{1}$. There is thus apparently great variation in the volume of fluid passing through the anterior abdominal vein relative to that passing through each renal afferent vein. I obtained the same variations in results on attempting to estimate the relative dimensions of the anterior abdominal vein and two renal afferent veins in *R. tigrina*. I adopted three methods for each vessel: (1) I calculated the area of the lumen in transverse section from the internal circumference (when × 103 diameters and drawn on Bristol board) and multiplied this into the average thickness of the wall (× 103); (2) the weight of the substance of the wall when magnified 103 diameters and drawn on Bristol board of uniform thickness; and (3) the squaring of the external diameter of the vessel. In two female *R. tigrina*, the first method gave the size of the anterior abdominal vein relative to that of each renal afferent vein as $\frac{1{\cdot}3}{1}$ and $\frac{1{\cdot}4}{1}$; in five *R. tigrina*, the second method gave the following values: $\frac{1{\cdot}6}{1}$, $\frac{1{\cdot}3}{1}$, $\frac{2{\cdot}1}{1}$, $\frac{1{\cdot}0}{1}$, $\frac{1{\cdot}0}{1}$, the average of which is $\frac{1{\cdot}4}{1}$; and the third method gave the values (in the cases of two frogs) of $\frac{1{\cdot}2}{1}$ and $\frac{1{\cdot}0}{1}$. There is thus some evidence for assuming that in *R. tigrina* the size, i.e. the blood-carying capacity, of the anterior abdominal vein is normally only a little greater ($\frac{1{\cdot}3}{1}$, $\frac{1{\cdot}4}{1}$) than that of each renal afferent vein. In the Indian toad, on the other hand we shall see (Appendix D) that the anterior abdominal vein is about three times as large as each renal afferent vein, and in *R. temporaria* about twice the size.

APPENDIX B.

Some Experiments recorded to illustrate the Statements on pp. 12, 13 of the Text.

Experiments which prove that, with correct relative flows in the renal arteries and renal afferent veins, variations of the nitrogen strength of the renal afferent vein fluid have no effect upon the nitrogen strength of the urine. In this first series of experiments fluids of the relative nitrogen strengths of 30 and 46 were perfused through the two renal afferent veins successively, i.e. both renal afferent veins contained the same fluid at the same time.

EXPERIMENT 1. Aortic cannula (tied into the coeliaco-mesenteric artery and the two systemics ligatured) had an outflow of 74 c.c. per minute at 24 cms. pressure, and the two renal afferent vein (r.a.v.) cannulae (tied into the two renal afferent veins which were cut posteriorly to the cannulae) had equal outflows of 11 c.c. per min. at 24 cms. pressure. Heart cut out to allow of free escape of fluid. The aortic perfusion fluid consisted of 0·6% saline (made with nitrogen-free distilled water—Nfdw), 30 c.c. of fresh stock human urine[1] being added to each 2000 c.c., and, after being filtered, perfused at a pressure of 26 cms. The nitrogen-strong perfusion fluid (stronger in nitrogen compared with the aortic fluid in the ratio of 46 : 30) used for the perfusion of the two r.a.v. consisted of 0·6% saline (Nfdw), 46 c c. of the same stock of human urine being added to each 2000 c.c. and filtered. I shall call this the 46 fluid. The nitrogen-weak perfusion fluid (of the same nitrogen strength as the aortic fluid) used for the perfusion of the r.a.v. consisted of 0·65% saline

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[1] At this time (1918), I "nitrogenized" the perfusion fluids by adding definite quantities of fresh human urine of uniform composition because I was unable to obtain urea crystals.

(a little extra salt being added to make the osmotic pressure of this fluid approximately equal to that of the 46 fluid, and, like the 46 fluid, stronger than that of the aortic perfusion fluid [1]). I shall call this the 30 fluid. In all experiments I always endeavoured to collect at least 1 c.c. of each sample of urine for nitrogen or other estimation.

Two r.a.v. bottles at 6 cms. pressure. Experiment set going at 8·50, the 30 fluid perfusing the two r.a.v. in the first phase of the experiment.

Put first pair of collecting tubes from 9·0–9·30

First Phase: 30 fluid in r.a.v.

9·0–9·30
1st left (IL) tube contained 1·6 c.c. urine. Not
,, ,, estimated
1st right (IR) ,, ,, 1·65 ,, [N.E.]

Substituted 2nd pair tubes from 9·30–10·15 (by which time the experiment was in good working order).
The contents of these two tubes added together
(IIL + IIR) = 5·2 c.c. (45 minutes) = “30 urine.”

9·30–10·15
Aorta perfused 571 c.c.
Left r.a.v. perfused 137 c.c. } = 4·5 : 1 flows.
Right r.a.v. ,, 115 c.c.

I then clamped the rubber tubes of the two r.a.v. cannulae, siphoned off most of the 30 fluid contents of the two r.a.v. bottles and substituted the 46 fluid, which on unclamping the rubber tubes, was perfusing the two r.a.v. by 10·25.

Put 3rd pair tubes from 10·30–11·0

Second Phase: 46 fluid in r.a.v.

IIIL + IIIR = 2·95 c.c. [N.E.]

Substituted 4th pair tubes from 11·0–11·45
IVL + IVR = 2·9 c c. (45 m.) = “46 urine.”

11·0–11·45
Aorta perfused 497 c.c.
L. r.a.v. ,, 135 c.c. } = 4·8 : 1 flows.
R. r.a.v. ,, 115 c.c.

Experiment stopped at 11·45.

1 c.c. 30 urine contained 0·000160 gm. Nitrogen.
1 c.c. 46 ,, ,, 0·000160 gm. ,,
1 c.c. 30 fluid ,, 0·000133 gm ,,
1 c.c. 46 ,, ,, 0 000200 gm. ,,

In this experiment therefore, the 30 urine and 46 urine samples were equal in nitrogen strength. The decrease in output of urine during successive periods of 30 minutes each during the course of the experiment is noteworthy: 3·25 c.c., 3·4 c c., 2·95 c.c., and 1·9 c.c.

I performed seven other experiments similar to this and obtained identical results. In half of these experiments I perfused the 30 fluid first, in the other half the 46 fluid first. As a check on these experiments I also performed two control experiments in which with 40 fluid (i.e. 0·6% saline + 40 c.c. human urine in each 2000 c c) in the renal afferent veins, I successively filled the *aortic* bottle with the same solution, with 50 fluid and with 61 fluid, and obtained samples of urine of increasing nitrogen strength: thus in one experiment I obtained urine samples of the following nitrogen strengths: 0·0000113 gm., 0·000140 gm., 0·00166 gm.

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[1] In experiments in which the r.a.v. 30 perfusion fluid was not made osmotically stronger than the aortic fluid (by the addition of sodium chloride) the 46 *urine* (i.e. the urine produced during perfusion with the 46 fluid) was found to be appreciably stronger in nitrogen than the 30 urine (e.g. 0·000253 gm. and 0·000186 gm. compared with 0·000173 gm. and 0·000133 gm respectively). This is but one of several of the various osmotic pressure relationships which I found to exist between the renal venous meshwork and the intertubular plexus. I hope to publish an account of these in a subsequent paper.

In one of the seven other experiments referred to, instead of excising the heart, I tied into it a wide-mouthed cannula with a short piece of rubber tubing attached. So long as this heart cannula and rubber tubing lay on the same horizontal level as the heart I obtained the normal results (the "30 fluid" of a nitrogen strength of 0·000046 gm. and "46 fluid" of a nitrogen strength of 0·000073 gm. both giving urine of a nitrogen strength of 0·000073 gm.) but on raising the end of the heart cannula rubber tubing, at the conclusion of the experiment when the 46 fluid was being perfused, to from 2 to 4 cms. above the level of the heart I at once obtained urine of a nitrogen strength of 0·000106 gm. and, when indigo-carmine was added to the r.a.v. fluid, of the color of dark blue ink! These results show clearly that when the outflow is obstructed and the pressure in the post-caval, renal venous meshwork and renal afferent vein therefore increased above normal, the 46 fluid makes its presence felt by actually penetrating into and re-enforcing, so to speak, the arterial fluid in the intertubular plexus, with the result that the urine increases in nitrogen strength and, when dye is present, becomes dark blue. We shall see later (Part III) that increase of pressure in the intertubular plexus *by itself* causes nitrogen-*weakening* of the urine (if the 30 fluid had been in the renal afferent vein when the heart cannula tubing was raised, the urine would have become weakened in nitrogen instead of strengthened) and it is only the penetration of the nitrogen-stronger (and dye-containing) renal afferent vein fluid into the intertubular plexus which produces the results just recorded.

In all of these experiments, the urine contained a greater percentage of nitrogen than the arterial fluid when the latter was at 24-26 cms. pressure. In one experiment I lowered the aortic bottle to 18 cms. and obtained urine of a nitrogen strength of 0·000253 gm., the arterial fluid being 0·000093 gm. and the 46 fluid 0·000193 gm. Decrease of pressure therefore strengthens the percentage of nitrogen in the urine. These facts effectually dispose of the notion that the "urine" of these experiments is a mere filtrate and not a true secretion.

In a second Experimental Series the experiments only differed from the preceding in that the 30 and 46 fluids were perfused simultaneously, each through one renal afferent vein, and the results obtained (eight experiments) were identical, the samples of urine obtained from the two kidneys being in all cases equal in strength.

Experiments performed to determine if Potassium ferrocyanide and Potassium iodide behave like the Nitrogen (and Indigo-carmine) of the preceding experiments.

EXPERIMENT 1. The aortic perfusion fluid consisted of 0·6% saline (Nfdw), 40 c.c. human urine being added to each 2000 c.c., perfused at 26 cms. pressure. The cannulae were the same as those used in the last Series. The two r.a.v. were first perfused, at 5 cms. pressure, with a 0·6% saline (Nfdw) solution containing 0·00625% of potassium ferrocyanide. This solution gives, when an equal volume of a weak stock solution of ferric chloride (the color of rather concentrated urine) is added, a distinct transparent blue coloration. As usual the heart was cut out and the two r.a.v. were cut behind the insertions of the cannulae. Other details as in preceding Series.

0·00625%
ferrocyanide
via r.a.v.

The experiment was set going at 8·45, and I put 1st pair tubes from 8·50–9·5

IL=1·4 c.c. (15 m.)
IR=1·3 c.c.

These samples, when mixed with equal volumes of the stock ferric chloride solution, were pure yellow in color.

Put 2nd pair tubes from 9·10–9·25
IIL = 1 c.c. (15 m.) + ferric chloride = yellow coloration only.
IIR = 1 c.c.

[aorta perfused 247 c.c.
9·10–9·25 l. r.a.v. „ 32 c.c. = 6·0 : 1 flows.
r. r.a.v. „ 50 c.c.]

At 9·28 I clamped both r.a.v., siphoned off the contents of the two bottles and substituted a 0·0125% solution (in 0·6% saline) of $K_4Fe(CN)_6$. The r.a.v. perfusion was re-started at 9·34, and I put 3rd pair tubes from 9·40–10·10.

·0125%
ferrocyanide
via r.a.v.

IIIL + IIIR = 1·8 c.c. (30 m.) + ferric chloride = yellow coloration only.

[aorta perfused 448 c.c.
9·40–10·10 l. r.a.v. „ 79 c.c. = 5·5 : 1 flows.
r. r.a.v. „ 83 c.c.]

At 10·12 I substituted in both r.a.v. bottles a 0·025% solution (in 0·6% saline) of $K_4Fe (CN)_6$ and re-started perfusion at 10·21.

0·025%
ferrocyanide
via r.a.v.

I put 4th pair tubes from 10·25-10·55
IVL + IVR = 0·8 c.c. (30 m.) + ferric chloride = yellow coloration only.

[aorta perfused 424 c.c.
10·25-10·55 l. r.a.v. „ 77 c.c. = 5·3 : 1 flows.
r. r.a.v. , 83 c.c.]

At 10·57 I substituted in both r.a.v. bottles a 0·05% solution of $K_4Fe (CN)_6$ (in 0·6% saline), *to each 2000 c.c. of which had been added 40 c.c. human urine—the osmotic pressure of this solution was therefore immensely superior to the preceding.*
The r.a.v. perfusion was re-started at 11·11.

0·05%
ferrocyanide
+ urine
via r.a.v.

I put 5th pair tubes from 11·20-11·50.
VL + VR = 0·9 c.c. (30 m.) + ferric chloride = yellow *with a slight green tinge.*

[aorta perfused 391 c.c.
11·20-11·50 l. r.a.v. „ 76 c.c. = 5·0 : 1 flows.
r. r.a.v. „ 79 c.c.]

At 11·52 I siphoned off most of the *aortic* bottle perfusion fluid (the tubing was not clamped) and substituted an identical solution save that it contained 0·00625% $K_4 Fe (CN)_6$; the aortic bottle was refilled by 11·58.

0·00625%
ferrocyanide
in aorta

I put 6th pair tubes from 12·5–12·20.
VIL + VIR = 0·4 c.c. (15 m.) + ferric chloride = a solution of a deeper blue than that obtained by adding the ferric chloride to the 0·00625% perfusion fluid itself.

Thus if we indicate the colorations given when the stock solution of ferric chloride is added, volume for volume, respectively to the 0·00625%, 0·0125%, 0·025% and 0·05% $K_4Fe(CN)_6$ perfusion fluids, by the numbers 1, 2, 4 and 8 (the 0·05% fluid became almost as blue as blue ink), the strongest 0·05% fluid + *the added urine* perfused via the renal afferent veins gave the urine a coloration of about 0·1 or 0·2, while the weakest 0·00 25% fluid perfused *via the renal arteries* gave the urine a coloration of at least 1·2. Since in all cases the aortic flow was at least 5 times as great as the average of the two renal afferent vein flows, it is impossible to suppose that the 0·05% solution (+urine, which gave a green tinge to the urine excreted) can have reached the intertubular plexus, much less the glomeruli, by reason of its fluid pressure; it is evident that it was due to its *increased osmotic pressure*, augmented as this was, not only by the greater percentage of $K_4Fe(CN)_6$ but also by the addition of urine. It is noteworthy then that with certain mixtures of substances an excess of osmotic pressure of the fluid in the renal venous meshwork above that normally obtaining, leads, like excess of fluid pressure, to admixture of the renal afferent vein fluid with the arterial fluid and a consequent change in the urine excreted.

EXPERIMENT 2. In the last experiment $K_4Fe(CN)_6$ was altogether absent in the renal arteries: in this experiment I decided to add it, as well as KI and urea crystals, to the arterial fluid as well as to the r.a.v. fluids, in the proportions of 30 to the former and 46 and 60 in the latter. Using Ringer's Fluid (see formula given by Bayliss, 6, on p. 211; I omitted the NaH_2PO_4 constituent) in this experiment instead of 0·6% saline, the three perfusion fluids were made up as follows:—

Aortic fluid = Ringer + 0·05% urea, 0·00625% ferro., 0·01% KI.
"46" ,, = Ringer + 0·0765% urea, 0·00958% ferro., 0·0153% KI.
"60" ,, = Ringer + 0·1% urea, 0·0125% ferro., 0·02% KI.

The cannulae were the same as those in the last experiment, the aortic bottle pressure being 24 cms. and that of the r.a.v. bottles at first 6 cms. Heart cut out and two r.a.v. cut behind cannulae. Experiment set going at 9·5 with the aortic perfusion fluid in both aorta and r.a.v.

"30" fluid in r.a.v. Put 1st pair tubes from 9·10–9·25.

IL + IR = cir. 0·2 c.c. (15 m) [N.E.]

At 9·30 I lowered the two r.a.v. bottles to 5 cms. to obtain a better flow ratio, and put 2nd pair tubes from 9·30–10·30.

IIL + IIR = 1·6 c.c. (60 m.) = "30" urine.

9·30–10·30	aorta perfused	452 c.c.	=4·1 : 1 flows.
	l. r.a.v. ,,	104 c.c.	
	r. r.a.v. ,,	116 c.c.	

At 10·32 I substituted "46" fluid in the two r.a.v. bottles and restarted perfusion at 10·37. I put 3rd pair tubes from 10·40–10·55.

"46" fluid in r.a.v.

IIIL + IIIR = cir. 0·1 c.c. (15 m.) [N.E.]

Put 4th pair tubes from 11·0–1·0.

IVL + IVR = 1·3 c.c. (120 m.) = "46" urine.

11·0–1·0	aorta perfused	889 c.c.	= 4·3 : 1 flows.
	l. r.a.v. ,,	198 c.c.	
	r. r.a.v. ,,	208 c.c.	

At 12·0 I raised the two r.a.v. bottles to 5·5 cms.

At 1·3 I substituted "60" fluid in the two r.a.v. bottles and re-started r.a.v. perfusion at 1·8. I put 5th pair tubes from 1·30–3·30.

"60" fluid in r.a.v.

VL + VR = 1·2 c.c. (120 m.) = "60" urine.

1·30–3·30	aorta perfused	897 c.c.	= 5·4 : 1 flows.
	l. r.a.v. ,	161 c.c.	
	r. r.a.v. ,,	167 c.c.	

At 1·30 I had lowered the two r.a.v. bottles to 5 cms. and at 2·10 to 4·5 cms.

From the three "30", "46", and "60" urine samples, and from the three perfusion fluids, I took exactly equal quantities of each (up to a mark on a pipette), put these in six small cylindrical tubes (of equal diameter) and added to each an equal quantity of the stock ferric chloride solution.

Aortic perfusion fluid sample = pale transparent bluish-green = 1
"46" ,, ,, ,, = transparent sky blue = 1·5
"60" ,, ,, ,, = deep sky blue = 2
"30" urine sample = pale transparent bluish-green = 1·2
"46" ,, = ,, ,, bluish-green = 1·2
"60" ,, = ,, ,, bluish-green = 1·2

All three urine samples were then identical in color (and a little deeper than the aortic perfusion fluid sample), despite the rise in strength of $K_4Fe\ (CN)_6$ in the r.a.v. fluids.

I took six more similar samples and added to the six tubes exactly equal quantities of concentrated corrosive sublimate solution: this produced in each case a pinkish opalescence which is quite distinct when the tube is viewed vertically over black paper. This method, though somewhat crude, gave results similar to those just recorded for $K_4Fe\ (CN)_6$.

I took six more samples and tested for nitrogen strengths, and found that these were in the ratios of 20, 30, 40, 22, 22, 22.

Thus all these results indicate that providing the flows are correct, the substitution of the stronger fluids in the renal afferent veins makes no difference to the $K_4Fe(CN)_6$, KI or nitrogen strengths of the urine excreted.

I performed two other experiments (one is described in Experiment 1, Appendix C) in both of which I successively perfused solutions of $K_4Fe\ (CN)_6$ and urea strengths of the ratios of 30, 60 and 90 (!) through the renal afferent veins and obtained results identical with those just described.

CONTROL EXPERIMENT. This experiment was identical with Experiment 2 just described save that the "46" and "60" fluids were perfused through the aorta instead of through the r.a.v. The flows varied between 3·7 and 4·5: 1 (the flows in the two r.a.v. being equal).

30 fluid IL+IR = 0·1 c.c. (15 m.) [N.E.]
in aorta IIL+IIR = 1·1 c.c. (45 m.) = 30 urine.

46 fluid IIIL+IIIR = 0·4 c.c. (15 m.) [N.E.]
in aorta IVL+IVR = 1·1 c.c. (30 m.) = 46 urine.

60 fluid VL+VR = 0·2 c.c. (15 m.) [N.E.]
in aorta VIL+VIR = 1·0 c.c. (75 m.) = 60 urine.

I took exactly equal quantities from all the three "30", "46" and "60" samples of urine and from the three perfusion fluids and added to each an equal volume of the stock ferric chloride solution, the results being as follows:—

If we denote the colorations of the "30", "46" and "60" perfusion fluid samples, as in the last experiment, by the figures 1, 1·5, 2, then

the color of the "30" urine sample was about 1·1
,, ,, ,, ,, "46" ,, ,, ,, between 1·3 and 1·4
,, ,, ,, ,, "60" ,, ,, ,, between 1·6 and 2

Precipitating the KI with concentrated corrosive sublimate gave similar results.

The nitrogen strengths of equal quantities of the "30", "46" and "60" perfusion fluids and the "30", "46" and "60" samples of urine were respectively in the ratios of 20, 30, 40, 20, 26, 32, the nitrogen strength of the urine therefore, with the K_4 Fe (CN)$_6$ and KI, increasing with the strength of the aortic perfusion fluid, thus contrasting with perfusion via the r.a.v.

APPENDIX C.

The Increase of Osmotic Pressure in the Renal Afferent Vein Fluid causes Increased Flow of the Arterial Fluid and consequently increased Rate of Urine Excretion.

On p. 18 I have stated that the substitution of fluids of increased osmotic pressure in the renal afferent veins accelerates the flow of the arteria fluid in the intertubular plexus and therefore the production of urine, providing that other conditions permit. It will be as well if I now adduce some concrete evidence in support of this assertion. The two experiments referred to on page 83 in illustration of the fact that even when solutions of $K_4Fe(CN)_6$ and urea three times as strong in these substances as the aortic fluid are perfused through the renal afferent veins, no diffusion or osmosis of these substances occurs, afford some of the evidence now required. I will describe the one which I first performed.

EXPERIMENT 1. In this experiment I made three perfusion fluids, each consisting of 0·6% saline (Nfdw), and with the following amounts of urea and ferrocyanide dissolved respectively in 2000 c.c. of the saline.

30 fluid. 1 gm. urea and 0·1250 gm. $K_4Fe(CN)_6$
60 fluid. 2 gms. ,, and 0·2500 gm. ,,
90 fluid. 3 gms. ,. and 0·3750 gm. ,,

The 30 fluid was perfused through the aorta throughout the experiment and at first through the two r.a.v. also, being followed by the 60 and 90 fluids through the two r a.v. As already stated in the text, the four samples of urine obtained in this experiment were indentical in nitrogen and ferrocyanide strength. Experiment set going at 9·15.

30 fluid 9·40–10·10 r.a.v. bottles at 6 cms. 1·85 c.c. urine in 30 minutes.

aorta perfused 483 c.c.
l. r.a.v. ,, 84 c.c.
r. r.a.v. ,, 110 c.c.
=4·9 : 1 flows.

60 fluid 10·40–11·10 r.a.v. bottles at 10 cms. 2·0 c.c. urine in 30 minutes.

aorta perfused 565 c.c.
l. r.a.v. ,, 116 c c.
r. r.a v. ,, 117 c.c.
=4·8 : 1 flows.

,, ,, 11·15–11·45 r.a.v. bottles at 12 cms. 2·0 c.c. urine in 30 minutes.

aorta perfused 556 c.c.
l. r.a.v. ,, 137 c.c.
r. r.a.v. ,, 152 c.c.
=3·8 : 1 flows.

90 fluid 12·15–12·45 r.a.v. bottles at 12 cms. 2·1 c.c. urine in 30 minutes.

aorta perfused 570 c.c
l. r.a.v. ,, 139 c.c.
r. r.a.v. ,, 165 c.c.
=3·7 : 1 flows.

The preceding data show (1) that the higher the osmotic pressure of the renal afferent vein fluid the greater the relative and absolute flow of the aortic fluid ;[1] (2) that greater fluid pressure in the renal afferent vein bottles diminishes the rate of aortic perfusion (seen in 60 fluid perufsion) ; and (3) that increase of osmotic pressure in the renal afferent vein fluid increases the rate of output of urine (which would otherwise have fallen considerably in the manner illustrated by most of the previous experiments).

Another experiment (Experiment 2) conducted in a similar way gave similar results. I also performed a third experiment (Experiment 3) similar to the two preceding but differing in that I ligatured the iliac arteries and was so able to estimate the change of rate of flow *in the renal arteries apart from that in the whole aorta.* I found in this experiment that the mere cutting-off of the venous supply (the flow in each r.a.v. was either 6 or 7 times that in the renal arteries !) had no effect whatever on the arterial rate of flow, but that perfusing a fluid through the r.a.v. containing three times as much urea as the aortic fluid increased the arterial flow from 30 c.c. in thirty minutes to 90 c.c. in the same time (!), though the rates of flow in the r.a.v. remained unchanged.

EXPERIMENT 4. In this experiment 0·6% saline with 30 c.c. human urine added to each 2000 c.c. was throughout perfused through the aorta and I successively passed pure 0·6%, 0·7% and 0·8% saline through the r.a.v., the two bottles remaining at 5 cms. Needless to say, with saline only in the r.a.v., the amount of urine produced was very small and the supply soon ceased with 0·6% saline in the r.a.v. but was partially revived with the 0·7% and 0·8% fluids. The chief purpose of the experiment is to demonstrate the acceleration of flow of the arterial fluid caused by the high osmotic pressures of the 0·7% and 0·8% saline fluids.

0·6%	10·55–11·15	11·0–11·20 (20 m.)
	1·2 c.c. urine.	aorta perfused 148 c.c. (× 6=888 c.c. in 120 m.
	(20 minutes)	l. r.a.v. ,, 40 c.c. × 6=240 c.c.
		r. r.a.v. ,, 62 c c. × 6=372 c.c
		=2·9 : 1 flows.
	11·20–1·20	11·20–1·20 (120 m.)
	cir. 0·2 c.c.	aorta perfused *709* c.c.
	urine (120 m.)	l. r.a.v. ,, 239 c.c.
		r. r.a.v. ,, 314 c.c.
		=2·5 : 1 flows.
0·7%	1·30–1·45	
	1 drop urine	
	(15 m.)	
	1·50–2·50	1·50–2·50 (60 m.)
	cir. 0·2 c.c	aorta perfused 432 c.c. (× 2=*864* c.c. in 120 m.
	urine (60 m,)	l. r.a.v. ,, 132 c.c. × 2=264 c.c.
		r. r.a.v. ,, 160 c.c. × 2=320 c.c.)
		=2·9 : 1 flows.
0.8%	3·20–3·50	3·20–3·50 (30 m.)
	cir. 0·3 c.c.	aorta perfused 279 c.c. (× 4=*1116* c.c. in 120 m.
	urine (30 m.)	l. r.a.v. ,, 71 c.c. × 4=284 c.c.
		r. r.a v. ,, 69 c.c. × 4=276 c.c.)
		=3·9 : 1 flows.

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[1] The figures given (483, 556, 570) represent the rate of out flow from the aorta perfusion bottle ; the increased rates of flow occur through the renal arteries only (see Exper. 3) and the effect of the raised osmotic pressure in the r.a.v. fluid is to be estimated not only by the increases shown by these figures but also by the absence of decrease of aortic flow which occurs in all experiments in which the perfusing fluid remains constant in quality.

Thus if we take for each of the three r.a.v. perfusing fluids the amount of arterial fluid which was or would be perfused in the space of two hours, these amounts are respectively 709 c.c., 864 c.c. and 1116 c.c.! Both the 0 7% and the 0·8% fluids stimulated the kidneys somewhat but the "habit" induced by the 0·6% fluid needs a stronger diuretic than osmotic pressure before this can be overcome. See also Experiment 10, Appendix E, Part II.

APPENDIX D.

On the Relative Sizes (Areas in transverse section) of the Anterior Abdominal and two Renal Afferent Veins in the Normal Control Toads enumerated in the Text, and in the Six Normal Control Specimens of Rana temporaria. The Resistances offered to the Passage of Venous Blood via the Renal Afferent Veins & the Anterior Abdominal Vein respectively.

All these toads and *R. temporaria* were preserved for a time in formalin (body cavity well exposed), and the veins (and other vessels) cut out, dehydrated and mounted in balsam with pieces of glass to prevent the vessels being distorted by the pressure of the coverslip. In all cases of measurement I did my best to estimate the *average* external diameter of each vessel, since the veins were frequently not uniform in thickness.

The following lists give my results:—

Toad.	(a) Ext. Diam. of Ant. Abdom. V.	(b) Ext. Diam. of One Ren. Aff. V.	(c) Ext. Diam. of Other Ren. Aff. V.	$\frac{(a)^2 \times 0{\cdot}7854}{(b)^2 \times 0{\cdot}7854 + (c)^2 \times 0{\cdot}7854}$
Normal Control Toad.	0·466 mm.	0·248 mm.	0·248 mm.	$\frac{1}{0{\cdot}56}$
Another Normal Control Toad.	0·684 mm. (very small)	0·713 mm.	0·666 mm.	$\frac{1}{2{\cdot}03}$
Control Toad U	0·341 mm. (very small)	0·341 mm.	0 372 mm.	$\frac{1}{2{\cdot}18}$
Control Toad W	0·558 mm.	0·356 mm.	0·356 mm.	$\frac{1}{0{\cdot}81}$
Control Toad No. 1	0·620 mm. (swollen)	0·232 mm.	0·155 mm.	$\frac{1}{0{\cdot}19}$
Control Toad No. 3	0·883 mm. (very swollen)	0·232 mm.	0·201 mm.	$\frac{1}{0{\cdot}11}$
Control Toad No. 4	0·620 mm.	0·356 mm.	0·310 mm.	$\frac{1}{0{\cdot}57}$
Control Toad No. 8	0·755 mm.	0·341 mm.	0·465 mm.	$\frac{1}{0{\cdot}58}$
Control Toad No. 9	0·620 mm.	0·403 mm.	0·403 mm.	$\frac{1}{0{\cdot}84}$

Control Toad No. 10	0·542 mm.	0·310 mm.	0·248 mm.	$\frac{1}{0{\cdot}58}$
Toad J (regenerated r.a.v.)	0·607 mm.	0·387 mm.	0·387 mm.	$\frac{1}{0{\cdot}61}$

If we leave out of consideration the aberrant ratios of the "Another Normal Control Toad," of Toad U and Toads Nos. 1 and 3 (in the first two of which the anterior abdominal is relatively abnormally small and in the latter two abnormally swollen), the mean of the remaining normal control toad ratios $= \frac{1}{0{\cdot}63}$ —a ratio (practically identical with that of J) which we may take as being the normal one in this species of Toad (*B stomaticus*). In other words, ***in these toads the anterior abdominal is a trifle more than three times as large as either of the renal afferent veins found in the same toad.***

In the six normal control specimens of *R. temporaria*, the figures were as follows:—

Frog	(a) Ext. Diam. of Ant. Abdom. V.	(b) Ext. Diam of One Ren. Aff V	(c) Ext. Diam. of Other Ren. Aff. V.	$\frac{(a)^2 \times 0{\cdot}7854}{(b)^2 \times 0{\cdot}7854 + (c)^2 \times 0{\cdot}7854}$
Control Frog No. 1	1·209 mm	0·821 mm	0·790 mm.	$\frac{1}{0{\cdot}88}$
Control Frog No. 2	1·224 mm.	0·682 mm.	0·899 mm	$\frac{1}{0{\cdot}84}$
Control Frog No. 3	1·085 mm	0·806 mm.	0·713 mm	$\frac{1}{0{\cdot}98}$
Control Frog No. 4	1·348 mm.	0·558 mm.	0·527 mm	$\frac{1}{0{\cdot}32}$
Control Frog No. 5	1·085 mm	0·775 mm.	0·651 mm.	$\frac{1}{0{\cdot}86}$
Control Frog No. 6	1·317 mm.	0·852 mm.	0·806 mm.	$\frac{1}{0{\cdot}79}$

If we omit the aberrant ratio of No. 4, we shall find that the average of the five remaining ratios $= \frac{1}{0{\cdot}91}$ or, in other words, ***the anterior abdominal is on the average, a trifle more than twice the size of each renal afferent vein,*** and is therefore smaller in proportion than the anterior abdominal vein of the toads.

The ratio of the abnormal frog OD $= \frac{1}{2{\cdot}07}$, the anterior abdominal therefore being about equal in size to each renal afferent vein, and therefore much smaller in proportion than the anterior abdominal of normal *R. temporaria.*

Since, in the normal Indian toad and in *Rana temporaria*, the anterior, abdominal vein is respectively about 3 times and 2 times, as large as each of the renal afferent veins, we may conclude that in the toad about 3/5 of the venous blood flows to the heart via the anterior abdominal and liver capillaries and 2/5 via the renal venous meshwork of both kidneys, and in *R. temporaria* about 1/2 of the blood flows through each of these two routes; in other words, the resistance to flow offered by the liver capillary system is in the toad about 1/3 and in *R. temporaria* about 1/2 of the resistance offered by the renal venous meshwork of *each* kidney. [1]

Further, in the abnormal frog OD (text-figure 4) with two non-portal kidneys, the anterior abdominal vein (sectional area = cir. 0·471 sq. mm.) is smaller in size compared with each (mean sectional area of the two "renal afferent" veins = cir. 0·649 sq. mm.) of the two "renal afferent" veins (posterior ends of the two posterior cardinals) in the proportion of 0·7 : 1·0, so that it would appear that the resistance to flow of the liver capillary system is only a little greater (cir. 1·4 times) than that of a vein opening directly into the main venous system; and this conclusion is confirmed by the veins of the abnormal frog CH (text-figure 5), the sectional area of the left (non-portal) "renal afferent" vein (posterior end of the posterior cardinal) being 0·570 sq. mm and that of the anterior abdominal being 0·679 sq. mm., whereas the sectional area of the right renal afferent vein (entering the normal "portal" kidney) was only 0·091 sq. mm. From these data then, we may conclude that the anterior abdominal vein and liver capillary system offer only a little more resistance to flow of venous blood into the heart than a persistent posterior cardinal vein opening directly into a precaval vein, but that, on the other hand, the renal venous meshwork of one kidney offers a resistance two (*R. temporaria*) or three (Indian toad) times as great.

APPENDIX E.

Details of the Perfusion Experiments on Frogs' Kidneys respectively with and without the Renal Afferent Vein Supply.

I supply the details of these experiments because my results, as regards the saline strengths of the samples of urine, are distinctly contradictory of those of Bainbridge, Collins and Menzies (*Proc. Royal Soc.*, Vol. 86, 1913), and because it is important that the data on which I have based the conclusions stated in the text should be available.

EXPERIMENT 1.—In this experiment only one cannula (74 c.c. per minute at 24 cms.) was used (inserted into the coeliaco mesenteric artery), the fluid being 0·6% saline + 40 c.c. human urine added to each 2,000 c.c., and perfused at 26 cms pressure. Heart exposed ventrally and ventricle cut off. The experiment was set going at 9·0, both the renal afferent veins (r.a.v.) being left open Put first pair of urine collecting tubes from 10·15–10·45.

Open. IL + IR [2] = 3·75 c.c. (30 minutes) = open vein urine [1 c.c. = O_1] [10·15–10·45 aorta perfused 363 c.c.].

At 10·46 I compressed the two r.a.v. between two pieces of glass tied together and supported laterally by pads of putty, so completely eliminating the flow. Between 10·50 and 11·20 I occasionally compressed the post-caval in order to fill out the two r.a.v. anterior to the glass slips, i.e. to re-establish the former fluid pressure in the renal venous meshwork. By 11·10 the two r.a.v. looked normal in size. I put second pair tubes from 11·20–11·50.

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[1] These estimates are of course only rough approximations sufficient for present purposes. I attempted to ascertain experimentally the relative flows of perfusion fluid via these two routes—the anterior abdominal and the two renal afferent veins respectively—but did not succeed owing to a wrong method being adopted. The only method is to make three cannulae with equal nozzle bores (i.e. with equal rates of flow at the same pressure) and to insert two of these into the two renal afferent veins and connect both to the branches of a forked tube connected with a perfusion bottle; the third cannula would have to be inserted into the posterior end of the anterior abdominal vein and connected with a second perfusion bottle, with a "head" of fluid equal to that in the other bottle.

[2] IL + IR = 1st left collecting tube urine contents + 1st right ditto.

Shut. IIL + IIR = 2·1 c.c. (30 m.) = shut vein urine (1st sample) [1 c.c. = S_1].

[11·20—11 50 aorta perfused about 350 c.c.].

Put third pair tubes from 11·55—12·25.

IIIL + IIIR = 1·5 c.c. (30 m.) = shut vein urine (2nd sample) [1 c.c. = S_2].

[11·55–12·25 aorta perfused 279 c c.].

Nitrogen Strengths.

O_1 = 0·000066 gm. in 1 c.c
S_1 = 0·000066 gm. ,, ,,
S_2 = 0·000066 gm ,, ,,
1 c.c perfusing fluid = 0·000073 gm. in 1 c.c.

Thus, providing that the pressure in the post-caval and connected veins remains approximately constant, the presence or absence of the venous supply to the kidneys makes no difference as regards the nitrogen strength of the urine. Nor so far is there any evidence that the rate of excretion of urine is affected.

EXPERIMENT 2.—Identical with the last save that the r.a.v. were ligatured and cut behind in the "shut vein" part of the experiment, that the cannula was smaller in bore (58·5 c.c. per minute at 24 cms.) and that the aortic bottle was lowered to 25 cms Heart cut out. Two r a.v. left open at commencement of experiment.

Open	IL+IR = 0·35 c.c. (30 m.) [N.E.] IIL+IIR = 1 85 c.c. (90 m.) [1 c c. = O]	Aorta perfused at rate of 288 c.c per 30 minutes.
Shut	IIIL+IIIR = 0·35 c.c. (13 m) [N.E.] IVL+IVR = 2·1 c.c. (90 m.) [1 c c. = S]	Aorta perfused at rate of 220 c c per 30 minutes

Chloride Strengths.

O = 0 003570 gm. in 1 c.c.
S = 0·004930 gm ,, ,,
1 c.c. perfusion fluid = 0·005848 gm. in 1 c.c

Nitrogen Strengths.

From what was left of the "shut" and "open" samples of urine I took equal quantities and found that the nitrogen strengths were in the ratio of 19 ("open") to 10 ("shut") I cannot account for this difference

EXPERIMENT 3.—Identical with Experiment 1, save that the aortic bottle was at 25 cms. pressure.

Open	IL+IR = 1 05 c.c. (30 m.) [N.E.] IIL+IIR = 1·7 c.c. (60 m.) [1 c.c. = O_1]	Aorta perfused at rates of 183 c.c & 161 c.c. per 30 minutes.
Shut	IIIL+IIIR = 0·7 c.c. (15 m.) [N.E.] IVL+IVR = 2·25 c.c. (60 m.) [1 c.c. = S_1]	Aorta perfused at rates of 223 c c & 222 c.c. per 30 minutes.
Open	VL+VR = 0·7 c.c. (15 m.) [N E.] VIL+VIR = 2·1 c.c. (60 m.) [1 c.c. = O_2]	Aorta perfused at rates of 213 c.c & 208 c.c. per 30 minutes.

Shut { VIIL + VIIR = 0·45 c.c. (15 m.) [N E.]
VIIIL + VIIIR = 1·8 c.c. (60 m.) [1 c c. = S_2] } **Aorta perfused at rates of 139 c.c. and 265 c.c. (!) per 30 minutes.**

Excretion still vigorous when experiment stopped.

Chloride Strengths.

O_1 = 0·004318 gm.
S_1 = 0·004998 gm.
O_2 = 0·004896 gm.
S_2 = 0·005304 gm.
1 c.c. perfusing fluid = 0·005848 gm.

The Nitrogen Strengths.

of equal quantities of O_1, S_1, O_2, S_2 were in the ratios of 2, 8, 13, 13, O_2 and S_2 therefore being equal in strength.

EXPERIMENT 4.—Identical with the last, save that the smaller cannula was used (58·5 c.c. per minute at 24 cms) and the two r.a.v. were shut to commence with.

Shut { IL + IR = 1·1 c.c. (30 m.) [N.E.]
IIL + IIR = 1·7 c.c. (60 m.) [1 c.c. = S_1] } Aorta perfused at the rate of 324 c.c. per 30 minutes.

Open { IIIL + IIIR = 0·7 c.c. (15 m.) [N.E]
IVL + IVR = 2·4 c.c (60 m.) [1 c c. = O] } Aorta perfused at the rates of 288 c.c. & 297 c.c. per 30 minutes.

Shut { VL + VR = 0·4 c.c. (15 m.) [N.E.]
VIL + VIR = 1·4 c.c. (60 m.) [1 c.c. = S_2] } Aorta perfused at the rates of 195 c.c. & 186 c.c. per 30 minutes.

Chloride Strengths.

S_1 = 0·004794 gm.
O = 0·005440 gm.
S_2 = 0·005372 gm.

The Nitrogen Strengths

of equal quantities of S_1 and O were in the ratios of 80 and 73, and were therefore practically equal.

EXPERIMENT 5.—Identical with the last save that the larger cannula was used (74 c.c. per minute at 24 cms.) and that a wide-mouthed cannula was tied into the ventricle of the heart.

Shut { IL + IR = 1·45 c c. (30 m.) [N.E.]
IIL + IIR = 2 5 c.c. (45 m) [1 c.c. = S_1] } Aorta perfused at the rates of 422 c c. & 326 c.c. per 30 minutes.

Open { IIIL + IIIR = 0 8 c c. (15 m) [N.E.]
IVL + IVR = 2·45 c.c. (45 m.) [1 c.c. = O] } Aorta perfused at the rates of 313 c.c. & 294 c.c. per 30 minutes.

Shut { VL + VR = 0·6 c.c. (15 m.) [N·E.]
VIL + VIR = 1·2 c.c. (45 m.) [1 c.c. = S_2] } Aorta perfused at the rates of 304 c.c. & 298 c.c. per 30 minutes.

Chloride Strengths.

S_1 = 0·005168 gm.
O = 0·005542 gm.
S_2 = 0·005406 gm.

The Nitrogen Strengths

of S_1 and O were in each case 0·000313 gm., both being therefore exactly equal.

EXPERIMENT 6.—Identical with the last save that the heart was cut out.

Shut	IL+IR = 0·15 c.c. (25 m.) [N.E.] IIL+IIR = 1·0 c.c. (60 m.) [1 c.c. = S_1]	Aorta perfused at the rates of 323 c.c. & 350 c.c. per 30 minutes.
Open	IIIL+IIIR = ? (15 m.) [N.E.] IVL+IVR = 0·8 c.c. (90 m.) [1 c.c. = O]	Aorta perfused at the rate of 406 c.c. per 30 minutes.
Shut	VL+VR = ? (13 m.) [N.E.] VIL+VIR = 0·7 c.c. (90 m.) [1 c.c. = S_2]	Rates of flow not recorded.

Chloride Strengths.

I took exactly equal quantities of S_1, O and S_2 and found that their chloride strengths were respectively in the ratios of 6·1, 7·1 and 7·5.

One possible defect in all the preceding experiments is the fact that while the renal afferent veins are open they are filled with fluid which comes from the legs, but when they are closed they become filled with fluid solely derived from the arteries, and we know that the former is stronger in nitrogen than the latter. But since we have already demonstrated in Part I that, provided the flow in the renal afferent veins is not excessive, a considerable excess in the nitrogen contents of the fluid in no way affects the nitrogen strength of the urine, this "defect" can be but of little or no consequence.

Another and perhaps more serious defect is that on the closure of the two renal afferent veins, all the blood returned from the legs must escape via the anterior abdominal vein alone. Since one channel must offer more resistance than three channels, this means that less fluid will enter the legs by the iliac arteries in a given time, that the fluid pressure in the aorta will thereby be raised and that therefore urine excreted under such increased pressure will be weaker in nitrogen (and stronger in chloride) than that excreted when the two renal afferent veins are open (Appendix G, Part III). To obviate any possibility of this defect being of importance I decided in the remaining experiments now to be described to insert cannulae into both renal afferent veins, cutting both of these behind the cannulae.

EXPERIMENT 7.—Aortic cannula had an outflow of 74 c.c. per minute at 24 cms. pressure, and the two cannulae for the r.a.v. had practically equal outflows of 11 c.c. per minute at 24 cms. pressure Aortic fluid consisted of 0·6% saline (tap water), 40 c.c. human urine being added to each 2,000 c.c., and was perfused at 25 cms. pressure; r.a v. fluid was similar save that 61 c.c. human urine were added. Two r.a v. bottles at 6 cms. pressure. Heart cut out and two r.a.v. cut behind cannulae. The experiment started with the two r.a.v. shut (i.e. the tubing was clamped)

Shut	IL+IR = 2·0 c.c. (30 m.) [1 c.c. = SN] IIL+IIR = 2·5 c.c. (45 m.) [1 c.c. = S_1]	Aorta perfused at the rate of 391 c.c. per 30 minutes.
Open	IIIL+IIIR = 0·4 c.c. (15 m.) [1 c.c. = ON] IVL+IVR = 1 2 c.c. (119 m.) [1 c.c. = O]	Flows were as 4·0 : 1, the aorta perfusing at the rates of 372 c.c. and 366 c.c. per 30 minutes.

Shut. VL+VR = 2·15 c.c. (120 m.) [1 c.c. = S_2] — Aorta perfused at the rates of 378 c.c. & 372 c.c. per 30 minutes.

Nitrogen Strengths.

SN = 0·000073 gm.
S_1 = 0·000073 gm.
ON = 0·000106 gm.
O = N.E. (insufficient after 1 c.c. set aside for chloride).
S_2 = 0·000073 gm.

Chloride Strengths (determined by Dr. A. P. Sircar).

S_1 = 0·005627 gm.
O = 0·005899 gm.
S_2 = 0·006086 gm.

Quantity of Urine.

Since while the veins were shut during the first phase of the experiment 4·5 c.c. of urine were excreted in 75 minutes, while the veins were open during the second phase of the experiment 1·6 c.c. of urine were excreted in 134 minutes and while the veins were shut during the third phase of the experiment 2·15 c.c. of urine were excreted in 120 minutes, it would appear from this one experiment that the shut condition of the veins is favourable to the production of urine, but this conclusion is not borne out by the results of other experiments.

Experiment 8.—Identical with the last experiment save that the r.a.v. were open to commence with. Two r.a.v. bottles at 6 cms. pressure.

Open { IL+IR = 0·2 c.c. (15 m.) [N.E.]
IIL+IIR = 2·45 c.c. (75 m.) [1 c.c. = O] } Flows varied between 3·8 to 5 4 : 1; aorta perfused at an average rate of 336 c.c. per 30 minutes.

Shut { IIIL+IIIR = 0·2 c.c. (15 m.) [N.E.]
IVL+IVR = 1·25 c.c. (120 m.) [1 c.c. = S] } Aorta perfused at an average rate of 290 c.c. per 30 minutes.

Chloride Strengths.

O = 0 005032 gm.
S = 0·004964 gm.

hence as in the first two chloride determinations of the last experiment, the "open vein" urine is slightly stronger in chloride than the "shut vein" urine, and this is the more remarkable in this experiment because the "shut vein" urine was excreted after the "open vein" urine. In most of these experiments the later the urine is excreted the stronger it is in chloride—a fact which is possibly explained by the walls of the kidney sinusoids (like other tissues) swelling with the salt and thus increasing the fluid pressure of the perfusing fluid, and increase of fluid pressure in the kidney is always correlated with an increase of the chloride content of the urine (see Part III).

Quantity of Urine.

This experiment furnishes no evidence in support of the view that the closure of the r.a.v. accelerates the production of urine.

Experiment 9.—Identical with the last experiment in all respects.

Open	IL + IR = 0·35 c.c. (15 m.) [N.E.] IIL + IIR = 1·4 c.c. (90 m.) [1 c.c. = O]	Flows varied between 3·5 & 4·6 : 1; aorta perfused at an average rate of 366 c.c. per 30 minutes.
Shut	IIIL + IIIR = 2 drops (15 m.) [N.E.] IVL + IVR = 1·45 c.c. (150 m.) [1 c c. = S]	Aorta perfused at an average rate of 382 c.c. per 30 minutes.

Chloride Strengths.

O = 0·005066 gm.
S = 0·005644 gm.

Quantity of Urine.

1·75 c.c. was excreted in 105 minutes with the veins open.
1·45 c.c. ,, ,, ,, 150 ,, ,, ,, ,, shut.

Experiment 10.—This experiment was primarily devised to ascertain if, when the r.a.v. are shut, the flow through the renal arteries is thereby increased. The experiment differs from the last in that both the iliac arteries were ligatured and the aortic bottle lowered to 18 cms. pressure, when the aorta looked normal in size. In all other respects the experiment was identical with the last and served the same purpose.

Open	IL + IR = 0·25 c.c. (15 m.) [N.E.] IIL + IIR = 2·0 c.c. (60 m.) [1 c.c. = O]	Renal arteries perfused at the rates of 50 c.c. and 47·5 c.c. per 30 minutes; the corresponding rates of flow of the two r.a.v. being 172 c.c. and 179 c.c.
Shut	IIIL + IIIR = a drop (15 m.) [N.E.] IVL + IVR = 0·4 c.c. (60 m.) [1 c.c. = S]	Renal arteries perfused at the rate of 44·5 c.c. per 30 minutes
Open.	VL + VR = 1 drop (60 m.) [N.E.]	Renal arteries perfused at the rate of 45·5 c.c. per 30 minutes; the corresponding rate of flow of the two r.a.v. being 193 c.c.

I then clamped the two r.a.v. tubes, siphoned off the fluid in the two r.a.v. bottles and replaced it with 0·6% saline + 90 c.c. human urine to each 2000 c.c. (i.e. a fluid of greater osmotic pressure) and then reopened the two r.a.v.

Open with stronger fluid. in r.a.v.	VIL + VIR = 0·6 c.c. (120 m.) [1 c.c. = 90 O]	Renal arteries perfused at the rates of 51 c.c. & 44·5 c.c. per 30 minutes and the two r.a.v. at 197 c.c. and 195 c.c.

Chloride Strengths.

O = 0·005134 gm.
S = 0·005396 gm.
90 O = 0·006141 gm.

Thus (1) the mere closure and emptying of the r.a.v. apparently does not affect the rate of flow through the renal arteries, which means that the fluid pressure in the renal venous meshwork must be normally very low;
(2) a fluid of higher osmotic pressure in the r.a.v. increases the rate of flow through the renal arteries and the rate of output of urine (and percentage of chloride ?)—vide Part I.[1]

To consider the conclusions which may be drawn from the results of the preceding ten experiments. First, as regards the relative quantities of urine excreted respectively (1) by kidneys with the renal afferent veins intact, and (2) by kidneys with the venous supply cut off, if we add together all the quantities of urine excreted under these two conditions and the times in which these quantities were excreted, in the preceding nine experiments, we find that, while the two renal afferent veins were open, 26·10 c.c. of urine were excreted in 854 minutes, and that, while the two renal afferent veins were closed, 31·60 c.c. of urine were excreted in 1,168 minutes; or, in other words, with a venous supply, the kidneys excreted at the rate of 35·69 c.c. in 1,168 minutes, and, with this venous supply cut off, at the rate of 31·60 c.c. in the same time—a difference of rate which, considering the small number of experiments performed, and the fact that the venous supply to the kidneys is about three times as great as the arterial supply, is negligible. But this comparison of the rates of excretion is subject to an important qualification. We have seen that during the course of each experiment the rate of excretion decreases rapidly whether the veins be open or closed and this being so, it is essential for just comparison that half the experiments should commence with the veins open and the other half with the veins closed. In the preceding ten experiments only four (Nos. 4–7) were commenced with the veins closed, hence the above comparison must be qualified by this consideration—a qualification which makes evident that the rates of excretion under the two conditions were even more equal than those I have already stated. Thus Miss Cullis' conclusion (16, p. 259) that "cutting out the venous perfusion makes practically no difference in the rate of secretion, even when the diuresis is at its height, and this is strongly against the idea that reabsorption plays any part in the secretory activity of the kidney in sulphate diuresis" is certainly correct (though I should omit the "practically") and agrees with the conclusion I have already foreshadowed in Part I.

If on the elimination of the kidney venous supply, the flow of urine remains unaltered, it follows, on the view that quantity of urine is proportional to blood-flow and not blood-pressure, that the rate of perfusion of the arterial fluid also remains unaffected and certainly does not increase. This further conclusion is borne out by the results of Experiments 7–10 (the results of Experiments 1–6 cannot be depended upon in this connection since the very act of closing the two renal afferent veins and compelling the whole of the fluid to escape by the anterior abdominal vein alone may retard the aortic flow) and by the results of another experiment which I performed especially for the purpose, the iliac arteries being ligatured and all precautions taken to avoid leakage. This last experiment also showed clearly, what has been demonstrated in Part I, that though the presence and absence of a venous "supply" of fluid of an osmotic strength of 46 as compared with the osmotic strength of 30 of the renal artery fluid do not affect the flow of fluid through the intertubular plexus and therefore the output of urine, yet changes in the osmotic pressure of the renal afferent vein fluid outside certain limits have considerable effect both on the rate of flow of fluid through the intertubular plexus and on the output of urine.

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[1] Conclusion (1) is founded upon this and two other similar experiments; conclusion (2) is based upon the results of at least a dozen experiments with different perfusing fluids (some recorded in Appendix C)

The opening and closing of the renal afferent veins in the preceding ten experiments cannot be said to have any definite, if any, effect on the nitrogen strength of the urine excreted. In the six experiments in which the nitrogen strengths of urine samples were estimated, the samples were of equal strength in three comparisons (Experiments 1, 3, 5) and in the remaining four comparisons (Experiments 2, 3, 4, 7) the "shut vein" and "open vein" urines were alternately the stronger.

Finally, it is of some importance to compare carefully the chloride (as NaCl) strengths of the samples of "shut vein" and "open vein" urine respectively in the preceding experiments on account of their theoretical significance. In making these comparisons however it is necessary, in order to obtain true comparisons, to recognize the fact that in every experiment the urine, at each change from "open vein" to "shut vein" or vice versa, apparently tends to gain in chloride strength, and it is necessary to allow for this factor. Again, it will be noticed that in Experiments 1-5, in which, when the renal afferent veins were shut, the whole of the fluid from the legs was compelled to escape by the anterior abdominal vein alone (thus raising the fluid pressure in the aorta) instead of as usual by way of three veins, the difference of chloride strength between the "shut vein" and the "open vein" urine samples is much greater than in Experiments 7-10, in which, owing to the two renal afferent veins being cut behind the cannulae, no such difference of pressure occurred in the aorta when the venous supply to the kidneys was cut off.

Comparing the chloride strengths of Experiments 2 and 3, in which the veins were at first open, with those of Experiments 4 and 5, in which the veins were at first shut (S_2 in both of these last experiments is omitted because there is no O_2 to balance it), we see that in Experiments 2 and 3.

the average strength of "open vein" urine was 0·004261 gm.
(three samples)
and ,, ,, ,, "shut vein" ,, ,, 0·005077 gm.
(three samples)
and in Experiments 4 and 5
the average strength of "shut vein" urine was 0 004981 gm.
(two samples)
,, ,, ,, ,, "open vein" ,, ,, 0·005491 gm.
(two samples)

We thus see that it solely depends on whether the experiment is started with veins open or shut as to whether or not the "shut vein" urine is stronger than the "open vein" urine or vice versa. It will be noticed that in Experiments 2 and 3 the difference of chloride strength between the strong "shut vein" urine and the weak "open vein" urine is certainly greater than the difference between the strong "open vein" urine and the weak "shut vein" urine in Experiments 4 and 5, and this is due to the fluid pressure factor I have already mentioned. In Experiments 2 and 3 the "shut vein" urine is stronger than the "open vein" urine not only because of the change from the one condition to the other but because of the increase of fluid pressure in the aorta due to the shutting of the veins;[1] in Experiments 4 and 5, on the other hand, the "shut vein" urine is already relatively strong in chloride owing to the high fluid pressure in the aorta and when the veins are opened, the only access of strength which the urine undergoes is due to the change of condition alone, hence the increase in chloride strength is less marked than in Experiments 2 and 3.

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[1] Possibly this factor accounted for the results of Bainbridge, Collins and Menzies (4).

Similar comparison of chloride strengths in Experiments 7–10 confirms this explanation. Thus in Experiments 8, 9, 10 (veins at first open)

the average chloride strength of " open vein " urine was 0·005077 gm.
(three samples)
and ,, ,, ,, ,, ,, " shut vein " ,, ,, 0·005334 gm.
(three samples)
and in Experiment 7
the chloride strength of " shut vein " urine was 0·005627 gm.
,, ,, ,, ,, " open vein " ,, ,, 0·005899 gm.

The difference of strength between the " open vein " and " shut vein " urines of Experiments 8, 9,10 was 0·000272 gm., and that of Experiment 7 was 0·000257 gm., these differences therefore being practically equal.

We therefore conclude from these results that the presence or absence of the kidney venous supply makes no difference to the chloride strength of the urine excreted, a conclusion we have already foreshadowed from the toad experiments described in Part II, and which will be further confirmed by the results of experiments on the living frog described in Part III. This conclusion however is opposed to that of Bainbridge, Collins and Menzies (4, p. 359) who maintain that " the urine obtained on a simultaneous arterial and venous perfusion does not, so far as we could determine, differ in amount from that obtained on an arterial perfusion alone, a simultaneous arterial and venous perfusion, however, seems to be more conducive to the formation of a *very dilute*[1] urine than is arterial perfusion alone."[2] It is impossible for me to indicate what I consider to be the particular fault in the experiments of these authors (and they quote no experiments at all similar to those I have described) because, from my standpoint, they (as well as those of their later paper, 5) are nearly all vitiated by the idea that the renal afferent veins supply the kidney tubules, and I demur entirely to such assumptions that, e.g. when the aorta is perfused with boiled Ringer's solution only the glomeruli are affected and that the tubules can be killed (except at great venous pressure) when the renal afferent veins are perfused with 1/10,000 mercuric chloride. Nor were these experiments conducted with any perception of the necessity of maintaining correct relative flows and osmotic pressures in the renal afferent veins and aorta, and on this account alone most of the results given are devoid of value from the present point of view.

APPENDIX F.

Mode of Preparation of the Frog in the Repetition of Gurwitsch's Experiments.

(*N.B.*—The following description also applies, with modifications, to the preparation of frogs for the perfusion experiments performed by me.)

The frog (always a male, so avoiding the oviducal veins, oviducts and large ovaries) is first deeply anaesthetized with ether, and, when well under, it is stretched out dorsal side upwards in a large dish with a cork or wax bottom by means of cords attached anteriorly to one or two digits of the arms and posteriorly to one or two of the digits of the hind limbs (thus restricting very little the circulation in the limbs). The whole of the cerebrum and optic lobes are then quickly removed (the two longitudinal cephalic veins lying underneath the fronto-parietals should not be cut, since loss of blood from every source must be avoided, low blood pressure preventing kidney secretion), thus ensuring permanent unconsciousness and at the same time leaving intact the respiratory centres. It is obviously all-essential that respiration should continue during the whole course of the experiment, and if it has temporarily ceased during the above operation I either wait until it is resumed naturally (and in the vast majority of cases this occurs) or stimulate its resumption by means of a small coil. For any experiment to succeed, the arterial blood must be bright red and the vessels full. When respiration is assured, the dorsal skin is then cut medianly at the hind end of the urostyle and continued along each side of the body to the base of the arms (avoiding the musculo-cutaneous and other large veins); it is then reflected over the head, all the small skin arteries arising medianly above the backbone being ligatured. Next the urostyle is cut through and raised so that the muscular body wall can be cut along each side of the vertebral column (external to the ribs) and turned down. All the dorso-lumbar veins (varying from two to five in number in this species) and small arteries arising from the dorsal side of the aorta (all visible when the vertebral column is raised) are then ligatured and cut on the distal side of the ligatures. Next the vertebral column is cut through at about the second or third vertebra and removed from here to the urostyle (thus effecting the extirpation of the lymph hearts which Cushny (17) considers so desirable), with the upper parts of the ilia (beware of small branches of the iliac arteries) and the portions of muscular body wall at the sides of the body. The stump of the vertebral column I tied to both sides of the dissecting dish to prevent lateral movements. The kidneys, the two ureters (lying above the rectum and converging posteriorly from under the two iliac arteries to open into the bladder) and all the large vessels and other viscera are now well exposed. I next remove the large nerves of the sciatic plexus on each side (to expose more completely the ureter, iliac artery and the renal afferent vein and to prevent reflex movements of the legs) and dissect out (an easy operation with practice) each ureter from near its opening into the bladder to its attachment to the kidney, pass it, under the iliac artery of that side and allow its extremity to rest inside the edge of a glass collecting tube, supported in a convenient position by a pad of putty. It is most necessary that the portion of ureter thus dissected out should be as long as possible, so as to allow for contraction when filled with urine: it is also necessary for the two ureters in each frog to be about the same length and for the opening of each collecting tube to be at the same level as the point of attachment of the ureter to the kidney, otherwise if two ureters were to pour out their excretions at different levels, the question of secretion pressure might have to be considered. There is no need whatever for a cannula to be inserted into the ureter—the urine flows quite freely so long as the ureter is not damaged in any way: at the same time it is advisable to watch the ureter when secretion has commenced in order to remedy any obstruction which may prevent the urine from passing out freely, but once the urine has passed (as it usually does with ease) it may be safely left. This method is preferable to the insertion of cannulae owing to its simplicity, and, provided that the opening of each collecting tube is kept well away from the rest of the body, there is no danger of fluid other than urine entering the tube Next the renal afferent vein on one side is ligatured, and the diuretic injected into some distant part of the body. Further, by means of two pairs of awls connected with string stretched across the ventral body wall under and anterior to the kidneys, and over the cut ends of the ilia, I prevented reflex movements from causing parts of the body to come into contact with the openings of the collecting tubes; I also inserted an awl at each side of the head to prevent this from moving unduly. Finally, I placed sufficient water in the dish to enable the ventral body wall to absorb this. Many frogs operated on as described lived for more than twenty-four hours, breathing and heart pulsation continuing until the end. All my experiments were carefully watched and if any imperfection were observed, the experiment was cancelled. I may also state that I should have found it impossible or at least much more difficult to conduct these operations from the ventral side of the frog, and I may add that had certain previous investigators performed their experiments from the dorsal side instead of from the ventral, there would have been no dispute as to whether they had or had not failed to ligature all the renal arteries supplying the kidneys, since by the dorsal method all are rendered plainly visible when the aorta is raised and they are put on the stretch.

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[1] My italics. The term " dilute " here refers to sodium chloride, the chief solid constituent.

[2] This assertion that while the total quantity of urine remains unaltered, the opening of the r.a.v. lowers the percentage of chloride in the urine implies that while salt is absorbed, water is not. My experience is that salt and water usually go together, i.e. whenever urine is weak in salt, it is also relatively strong in nitrogen, or, in other words, deficient in water (see Appendix G, Part III).

APPENDIX G.

Experiments on the Frog illustrating the Facts that (the Venous Supply of the Kidneys being eliminated) Increase of Pressure in the Aorta (i.e. Greater Pressure and Greater Rate of flow) yields Urine weaker in Nitrogen, stronger in Chloride and greater in Quantity, whereas Increase of Pressure in the Post-caval Vein (i.e. Greater Pressure and Less Rate of Flow) yields Urine also weaker in Nitrogen and stronger in Chloride but less in Quantity: in other words, the Quality of the Urine depends on the Pressure, the Quantity on the Rate of Flow.

Increase of Pressure in the Aorta (Exp. Ser. A.I.P.).

EXPERIMENT 1 (for nitrogen strengths of urine). Perfusion fluid consisted of 1 gm.[1] urea crystals dissolved in 2000 c.c. 0·6% saline (tap water), perfused through a large-bore cannula (outflow of 74 c.c. per minute at 24 cms.) tied into the coeliaco-mesenteric artery (the two systemics being ligatured). Heart cut out and the two iliac arteries and two r.a.v. ligatured. Perfusion bottle first put at 20 cms pressure and perfusion started at 8·40.

20 cms. Put 1st pair tubes from 9·15–10·45.
IL + IR = 1·5 c c. (90 m.) = 1st 20 cms urine.
[9·15–10·45 renal artery rate of flow=17·3 c.c. per 30 minutes.]
At 10·46 perfusion bottle raised to 30 cms.

30 cms. Put 2nd pair tubes from 11·0–11·30.
IIL + IIR = 1·2 c.c. (30 m.) = 1st 30 cms. urine.
[11·0–11·30 renal artery rate of flow = 50 c.c. per 30 minutes.]
At 11·31 perfusion bottle raised to 40 cms.

40 cms. Put 3rd pair tubes from 11·45–12·15.
IIIL + IIIR = 1·25 c c. (30 m.) = 1st 40 cms. urine.
[11·45–12·15 renal artery rate of flow = 115 c.c. per 30 minutes.]

It is evident that 30 cms. gave the optimum flow for kidney excretion in this experiment. Though the flow at 40 cms. pressure was more than doubled yet the amount of urine excreted remained about the same, and, as will be seen, was decidedly weaker in nitrogen. This result would not occur if the excretion were a mere glomerular filtration.

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[1] Experiments in which stronger solutions than this were used did not give such clear results.

At 12·17 I lowered the perfusion bottle to 30 cms.
30 cms. Put 4th pair tubes from 12·30–1·30.
IVL + IVR = 1·7 c.c. (60 m.) = 2nd 30 cms. urine.
[12·30–1·30 renal artery rate of flow = 89·5 c.c. per 30 minutes.]
At 1·31 perfusion bottle lowered to 20 cms.
20 cms. Put 5th pair tubes from 1·45–2·45.
VL + VR = 1·05 c.c. (60 m.) = 2nd 20 cms. urine.
[1·45–2·45 renal artery rate of flow = 46·5 c.c. per 30 minutes.]
At 2·47 I raised the perfusion bottle again to 40 cms.
40 cms. Put 6th pair tubes from 3·0–3·30.
VIL + VIR = 1·35 c.c. (30 m.) = 2nd 40 cms. urine.
[3·0–3·30 renal artery rate of flow = 159 c.c. per 30 minutes.]

Nitrogen Strengths.

1st 20 cms. urine = 0·000300 gm.
1st 30 cms. ,, = 0·000260 gm.
1st 40 cms. ,, = 0·000213 gm.
2nd 30 cms. ,, = 0·000186 gm.
2nd 20 cms. ,, = 0·000220 gm.
2nd 40 cms. ,, = 0·000180 gm.
1 c.c. perfusing fluid = 0·000233 gm.

These results prove clearly (1) that with increase of pressure in the aorta (renal arteries) the nitrogen content of the urine diminishes (for an example of low pressure giving urine strong in nitrogen, see experiment mentioned on p. 12 , Part I); (2) that with increase of pressure (and rate of flow) up to 30 cms. the quantity of urine excreted increases, but that beyond this (optimum) pressure, the increased flow in the renal arteries is unable to produce an increased quantity of urine; (3) that the nitrogen strengths and quantities of the 2nd 30 cms. urine and 2nd 20 cms. urine show clearly the effect of the previous 40 cms. pressure—kidney cells, like other living tissues, show well the *law of habit* (Adami) or law of inertia (Weigart, 1896)—“the law that once a cell is stimulated to perform a certain act, it continues to perform that act for some time after the stimulus has ceased to be in operation”—a law which is quite inexplicable on the neo-Ludwig view of the mode of function of the kidney.

EXPERIMENT 2 (for nitrogen strengths of urine). Identical with the last experiment The results, as will be seen, were similar, the only difference being that the maximum 40 cms. pressure had more effect in increasing the quantity of urine excreted.

Quantities and Nitrogen Strengths.

1st 20 cms. urine (0·9 c.c. in 150 m.) = 0·000361 gm.
1st 30 cms. urine (1·7 c.c. in 60 m.) = 0·000280 gm.
1st 40 cms. urine (1·2 c.c. in 30 m.) = 0·000213 gm.
2nd 30 cms. urine (1·2 c.c. in 60 m.) = 0·000166 gm.
2nd 20 cms. urine (0·7 c.c. in 60 m.) = 0·000280 gm.
1 c.c. perfusing fluid = 0·000233 gm.

I performed two other experiments similar to the above, only differing in that the fluid escaped via the cut systemics (the heart not being cut out) and using 0·5% saline (tap water), 4 c.c. human urine being added to each 2000 c.c. as the perfusion fluid, and obtained the same results.

I will recapitulate one more experiment to illustrate the fact that increase of fluid pressure in the renal arteries *increases* the *chloride* strength of the urine excreted (thus having the opposite effect to that just described for nitrogen).

EXPERIMENT 3 (for chloride strengths of urine). Identical with Experiment 2 The perfusion fluid was the same, but I must remark that, though labelled 0·6% saline, it was probably (owing to the salt being moist when weighed) of lower strength than this. I neglected to ascertain the exact chloride strength of the perfusing fluid in this experiment.

Quantities and Chloride Strengths (Mohr method).
1st 20 cms. urine (1·5 c.c. in 120 m.) = 0·005202 gm. in 1 c.c.
1st 30 cms. urine (1·7 c.c. in 60 m.) = 0·005950 gm. ,, ,,
1st 40 cms. urine (1·9 c.c. in 60 m.) = 0 006154 gm. ,, ,,

Thus increase of pressure in the arterial fluid increases the chloride strength of the urine—a conclusion I have confirmed in many other experiments.

Dr. A.P. Sircar in all cases estimated for me the chloride strengths.

Increase of pressure in the Post-Caval Vein (Exp. Ser. P.C.I.P.).

EXPERIMENT 1 (for nitrogen strengths of urine). Perfusion fluid and cannula as in preceding experiments. Wide-mouthed cannula tied into heart, with short length of rubber tubing attached. Two iliac arteries and two r a.v. ligatured. Gut, fat-bodies and gonads all retained intact, as in previous experiments, to avoid leakage. Aortic perfusion maintained at 30 cms. pressure throughout experiment. Heart cannula and tubing lie in the same horizontal plane as the heart at the commencement of the experiment = 0 cm pressure. Experiment set going at 8·45.

0 cm. 9·15–10·15 IL + IR = 1·75 c.c. (60 m,) = "0 cm. urine."
,, renal artery rate of perfusion = 76 c.c. per 30 minutes.
,, heart cannula rate of outflow = 71 c.c. per 30 minutes.

I then raised the end of the heart cannula tubing to 2·5 cms. above the level of the heart, at which height the escaping fluid dropped into a measuring tube.

2·5 cms. 10 30–11·0 IIL + IIR = 1·4 c.c. (30 m.) = "2·5 cms. urine"
,, renal artery rate of perfusion = 94 c.c. per 30 minutes.
,, heart cannula rate of outflow = 82 c.c. per 30 minutes.

At 11·2 I raised the heart cannula tubing to 5 cms.

5·0 cms. 11·15–12·15 IIIL + IIIR = 1·0 c.c (60 m.) = "5·0 cms. urine."
,, renal artery rate of perfusion = 115·5 c.c. per 30 minutes.
,, heart cannula rate of outflow = 59 c.c. per 30 minutes.

At 12·17 I raised the heart cannula tubing to 7·5 cms.

7·5 cms. 12·30–2·30 IVL + IVR = 1·35 c.c. (120 m.) = "7·5 cms. urine."
,, renal artery rate of perfusion = 131 c.c. (!) per 30 minutes.
,, heart cannula rate of outflow = nil (!)
Either the aortic fluid was lost by extravasation or by rupture of a vein under the great pressure in the post-caval.

At 2·31 I lowered the heart cannula tubing to 0 cm. again.

0 cm. 2·45–3·30 VL + VR = two small drops (45 m.) N.E.
,, renal artery rate of perfusion = 167 c.c. per 30 minutes.
,, heart cannula rate of outflow = 125 c.c. per 30 minutes.
the leakage being the results of the previous high pressure.

Nitrogen Strengths.

"0 cm. urine" = 0·000126 gm.
"2·5 cms. urine" = 0·000113 gm.
"5·0 cms. ,, " = 0·000110 gm.

"7·5 cms. urine" = 0·000080 gm.
1 c.c. perfusing fluid = 0·000233 gm.

Thus, though the raising of the heart cannula pressure from 0 cm. to 2·5 cms. did not lower the rate of flow of fluid through the kidney, this, with the rate of excretion, slightly increasing, yet the 2nd sample of (2·5 cms.) urine was weak in nitrogen compared with the first. Subsequent samples of urine exhibit clearly the decrease in nitrogen strength and rates of excretion of the urine samples consequent on the raising of the fluid pressure in the post-caval vein (and kidney capillaries).

Experiment 2 (for nitrogen and chloride strengths of urine). Identical with the last experiment. Experiment set going at 9·30.

0 cm. 10 0–11·0 IL + IR = 1·45 c.c. (60 m.) = "1st 0 cm. urine."
,, renal artery rate of perfusion = 56·5 c.c. per 30 minutes.
,, heart cannula rate of outflow = 52 c.c. per 30 minutes.

At 11·1 I raised the heart cannula tubing to a height of 5 cms. above the level of the heart (at 11·5 both the ligatured r.a.v. are well filled out).

5·0 cms. 11·20–11 50 IIL + IIR = 1·4 c.c. (30 m.) = "1st 5·0 cms. urine."
,, renal artery rate of perfusion = 71 c.c. per 30 minutes.
,, heart cannula rate of outflow = 48·5 c.c. per 30 minutes.

At 11·52 I raised the heart cannula tubing to 7·5 cms.

7·5 cms. 12·5–12·35 IIIL + IIIR = 1·25 c.c. (30 m.) = "7·5 cms. urine."
,, renal artery rate of perfusion = 66 c.c. per 30 minutes.
,, heart cannulae rate of outflow = nil.

At 12·36 I lowered the heart cannula tubing to 0 cm. again (when a lot of fluid flowed out of the tubing).

0 cm. 12·50–1·35 IVL + IVR = 1·4 c.c. (45 m.) = "2nd 0 cm. urine." (IVR contains about 3 times as much urine as IVL: IIIR contained only a slight excess over IIIL).
,, renal artery rate of perfusion = 86 c.c. (!) per 30 minutes.
,, heart cannula rate of outflow = 78·3 c.c. per 30 minutes.

At 1·39 I raised the heart cannula tubing again to 5 0 cms.

5·0 cms. 1·50–2·20 VL + VR = 1·35 c.c. (30 m.) = "2nd 5·0 cms. urine." (VR contained only a little more urine than VL.)
,, renal artery rate of perfusion = 79 c.c. per 30 minutes.
,, heart cannula rate of outflow = 33 c.c. per 30 minutes.

At 2·21 I lowered the heart cannula tubing again to 0 cm.

0 cm. 2·35–3·5 VIL + VIR = 1·1 c.c. (30 m.) = "3rd 0 cm. urine."
,, renal artery rate of perfusion = 90 c.c. per 30 minutes.
,, heart cannula rate of outflow = 81 c.c. per 30 minutes

Nitrogen and Chloride Strengths.

"1st 0 cm. urine" = 0·000166 gm. Nitrogen, and Chloride in the proportion of 1·9.[1]

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[1] These chloride quantities are only expressed as ratios because the samples of urine for chloride estimation were in each case taken up

"1st 5·0 cms. urine" = 0·000153 gm. Nitrogen, and Chloride in the proportion of 2·0.
"7·5 cms. urine" = 0·000126 gm. Nitrogen, and Chloride in the proportion of 2·1.
"2nd 0 cm. urine" =0·000080 gm. Nitrogen, and Chloride in proportion of 2·1.
"2nd 5·0 cms urine"=0·000180 gm. Nitrogen (Chloride N.E.).
"3rd 0 cm. urine"= 0·000100 gm. Nitrogen (Chloride N.E.).

Allowing for the unaccountable oliguria of the left kidney in the middle of the experiment and the natural decrease of rate of excretion as the experiment proceeds, the preceding data show well the connection between rate of flow of fluid and amount of urine excreted, the law of habit and the other results to which I have already referred.

Experiment 3 (for chloride strengths of urine). Identical with the last experiment. Experiment set going at 8·55.

0 cm. 9·25–10·25 IL + IR = 1·4 c.c. (60 m.) = "0 cm. urine."
,, renal artery rate of perfusion = 35·5 c.c. per 30 minutes.
,, heart cannula rate of outflow = 35·5 c.c. per 30 minutes.

At 10·26 I raised the heart cannula tubing to a height of 2·5 cms.

2·5 cms. 10·40–11·40 IIL + IIR = 1·5 c.c. (60 m. = "2·5 cms. urine."
,, renal artery rate of perfusion = 42·5 c.c. per 30 minutes.
,, heart cannula rate of outflow = 35·5 c.c. per 30 minutes.

At 11·41 I raised the heart cannula tubing to 5·0 cms.

5·0 cms. 11·55–1·25 IIIL + IIIR = 1·25 c c. (90 m.) = "5·0 cms. urine."
,, renal artery rate of perfusion = 36·3 c.c. per 30 minutes.
,, heart cannula rate of outflow = 6 c c. per 30 minutes (at 11·45 the two r a.v. were both well swollen).

At 1·26 I raised the heart cannula tubing to a height of 7·5 cms.

7·5 cms. 1·40–3·10 IVL + IVR = 1·1 c.c. (90 m.) = "7·5 cms. urine."
,, renal artery rate of perfusion = 33·3 c.c. per 30 minutes.
,, heart cannula rate of outflow = nil.

At 3·12 I lowered the heart cannula tubing to 0 cm.

0 cm. 3·25–3·55 VL + VR = 2 small drops (30 m.) N.E.
,, renal artery rate of perfusion = 35 c.c. per 30 minutes.
,, heart cannula rate of outflow = 33 c.c. per 30 minutes.

Chloride Strengths.

0 cm.	urine	0·005678 gm.
2·5 cms.	,,	0·005848 gm.
5·0 cms.	,,	0.005940 gm.
7·5 cms.	,,	0·006124 gm.

These results confirm those previously obtained. I performed one other experiment similar to this and obtained similar results, which I need not record.

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to a mark on the pipette, and the volume up to this mark I did not determine. These and all other chloride determinations were made by Dr. A. P. Sircar

The results of the preceding nine experiments (six recorded and three mentioned) prove, as explained in the text, that quantity of urine is, other things equal, dependent upon the rate of flow of the fluid perfusing the intertubular plexus,[1] and that the quality of the urine likewise depends upon the pressure whether this comes from the aorta or the post-caval. The reverse current experiments described in Part IV further prove that quantity of urine also depends, other things equal, upon the volume of the perfusing fluid, since the enormous output of urine during the reverse current can only have been due to the unusual filling of the tubule capillaries (unprotected by glomeruli) Flow without volume is impotent to produce urine (this is the explanation of the fact that whenever the arterial pressure falls below a certain point the flow of urine fails—the pressure is not sufficient to force a sufficient "trickle" of fluid through the efferent glomerular vessels; on the other hand, fluid under a very low pressure perfused via the renal vein, and therefore traversing no glomeruli, gives an ample supply of urine) and likewise volume without flow is equally impotent, as is indicated by the experiments of Exp. Ser. P.C.I.P. On several occasions I tried in the frog the experiment of perfusing saline and urea via the aorta at 40 cms. pressure and then ligaturing the post-caval, the aorta behind the kidneys and the renal afferent veins, but in each case there was so much extravasation that it was impossible to prevent flow. and this flow, together with the high pressure (and consequent large volume) and urea diuretic, gave a good supply of urine very weak in nitrogen. It must be mentioned that the presence of diuretics like urea in the perfusing fluid can apparently compensate for lack of flow to a very large extent, perhaps altogether (vide e.g. the experiments of Bainbridge and Beddard (3), and other authors)

APPENDIX H.

Reversal of the Current of Perfusing Fluid through the Kidney.

Experimental Series 1.—Perfusion through the frog's kidney in the reverse direction to the normal.

EXPERIMENT I. [In this experiment I first attempted to obtain a sample of urine with 0·6% saline (tap water) only in the aorta (at 25 cms. pressure), the tubing of the cannulae inserted into the two r.a.v. being clamped. The heart was cut out and the two r a.v. cut behind the cannulae. The experiment was set going at 9·15, the two r.a.v. cannulae being closed immediately after insertion. Between 9·15 and 10·10 less than 0·2 c c. urine had been excreted, although between 9·20 and 10·10, 407 c.c. of fluid had perfused through the aorta.]

[0·6% saline in aorta: r.a v. closed.]

Saline + nitrogen in aorta: r a v. closed.

At 10 12 I substituted in the aortic bottle 0·6% saline (tap water), each 2000 c.c. containing 30 c.c. human urine. Put collecting tubes from 10 30–11·30 and collected 1 c.c. urine [1 c.c. = DC (direct current urine)].

[10·30–11·30 aorta perfused 695 c.c. (increased flow due to increased osmotic pressure)].

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[1] A fact also well illustrated by the acceleration of the actual flow due to increase of osmotic pressure in the renal afferent vein (see p. 18 Part I).

[30 fluid in r a.v. renal arts. closed.]

[At 11·30 I clamped the aortic bottle tubing and so closed the arterial supply, and opened the two r.a.v. cannulae and perfused the fluid, lately in the aorta, through the r.a v. at first at 6 cms. pressure. At 12·0 I raised the r.a v. bottles to 12 cms. and at 12·30 to 18 cms. Between 11·45 and 1·45 only one drop of urine obtained.

[11·45–1·45. l.r.a.v. perfused 747 c.c. and the r. r.a.v 764 c.c.]].

Reverse current of 30 fluid.

At 1·45 I opened the aortic cannula and lowered the aortic bottle to 9 cms. *below* the level of the heart, and ligatured the post-caval vein, so forcing the r.a.v. fluid to make its exit from the kidneys by the renal arteries, i.e reversed the current; I also raised the two r a v. bottles to 24 cms. (i.e. aortic) pressure The two r.a.v. were of course enormously swollen and most of the fluid escaped via the iliac arteries and by extravasation, very little fluid entering the aortic bottle. By 1·48 urine secretion had become vigorous. Between 1·45 and 2·15,4 c.c. (!) of urine had been excreted [1 c.c. = RC (reverse current urine)].

[1·45–2·15, l. r.a.v. perfused 205 c.c.; r. r.a.v. perfused 171 c.c. (the flows between 1·0 and 1·30, i.e. before the r.a.v fluid was compelled to escape via the renal arteries, were 215 c.c. and 210 c.c. respectively)].

DC = 0·000193 gm. Nitrogen.
RC = 0·000140 gm. ,,
1 c.c. 30 fluid = 0·000153 gm. ,,

Thus with the direct (normal) current fluid flowing through both kidneys at a rate of about 70 c c. per 30 minutes (i e. 1/5 of the total aortic flow—see Appendix B, Part I) at 25 cms. pressure via the renal arteries, 0·5 c.c. urine was obtained in 30 minutes, whereas with the reverse current flowing at a rate of about 376 c.c. per 30 minutes at 24 cms. pressure through both kidneys via the two renal afferent veins, 4 c.c. urine (i.e. 8 times as much) were obtained in the same time (30 minutes). There is thus shown a fairly close proportionality between the quantity of perfusing fluid (rate of flow and volume) in the intertubular plexus and the quantity of urine produced, but no relationship at all between glomerular pressure and urine quantity. Moreover the excessively swelled condition of the veins in this, as in the following experiments, certainly did not prevent urine being secreted. During the arterial flow the glomeruli of course reduced the arterial pressure considerably in the intertubular plexus, while in the renal afferent vein flow the pressure in the veins was much higher than normal, hence the RC urine is weaker in nitrogen than the DC urine (vide Appendix G).

EXPERIMENT 2. In this experiment I first perfused 0·6% saline (tap water) + 0·05% urea through the aorta at 24 cms. pressure. The heart was not cut out but a hole was made in the post-caval vein for escape of fluid. Both iliac arteries and r.a.v. ligatured. Experiment set going at 10·10 and first pair tubes put from 10·40–12·10.

Arterial perfusion.

IL + IR = 1·65 c.c (9) m.) [1 c.c. = DC].
[10·40–12·10 renal arteries perfused about 16 c.c. (by an oversight I omitted to note the exact quantity).]

At 12·15 I inserted the same cannula under the same conditions into the post-caval vein, when the vein of course became enormously swollen and the renal arteries, which I cut, became stiff with the escaping fluid. From 12·30–1·0 I put second pair tubes.

Post-caval perfusion.

IIL + IIR = 4·65 c.c. (30 m.) [1 c.c. = RC].

(12·30–1·0 the post caval vein perfused 1187 c.c. (!) most of which was doubtless lost by extravasation through the walls of the post-caval itself and the intertubular capillaries or perhaps via the nephrostomes which open into the veins.)

DC = 0·000215 gm. Nitrogen.
RC = 0·000153 gm. ,,
1 c.c. perfusing fluid = 0·000153 gm. ,,
DC = 0·005406 gm. Chloride as NaCl.
RC = 0·006154 gm. ,, ,, ,,

so, as usual, excess of pressure weakens the urine in nitrogen and strengthens it in chloride (Appendix G). The other results are as in the preceding experiment, the reversal of flow increasing the quantity of urine by about 8·5 times, while the reversed quantity of fluid perfused was about 7 times that of the direct quantity of fluid perfused (probably a little more since I noted at the time of the experiment that the number 160 should probably have been lower).

In a third experiment (Experiment 3), with the aortic bottle at 30 cms. during arterial perfusion (rate of flow = 61 c c. per 30 minutes) and *reduced to* 15·5 *cms. during post-caval perfusion* (rate of flow = 167 c.c. per 30 minutes) I obtained 3·0 c.c. urine of 0·000066 gm nitrogen strength with arterial perfusion and 2·7 c.c. urine of 0·000106 gm. nitrogen strength with post-caval perfusion—*the reverse current thus at half the pressure producing nearly the same quantity of much stronger urine.* The two samples of urine were nearly equal in chloride strength, being 0·005916 gm chloride and 0·006188 gm. chloride respectively. These results imply that the pressure in the intertubular plexus was less during the post-caval perfusion than during the arterial perfusion, much of the fluid during the former probably extravasating and therefore not reaching the plexus.

Two other experiments gave similar results.

In all five experiments the quantities of urine bore no relation at all to the pressures either in the glomeruli or in the intertubular plexus: on the other hand, though no strict proportionality apparently existed, yet there was always some relation between the volume and rate of flow of the perfusing fluid and the quantity of urine

Experimental Series 2.—Perfusion of the rabbit's kidney via the renal vein with 0·75 saline containing 100 c.c. human urine in each 2000 c.c at 100 cms. (water) pressure.

EXPERIMENT 1.—Female rabbit. The perfusing fluid in the bottle was kept at an almost constant temperature of 41° C. (not varying more than 1°) by means of boiling water circulating through a coil of rubber tubing placed inside the bottle. The temperature of the fluid in the kidney was of course several degrees lower than this but exactly how much lower was not ascertained. Two tubes led off from the neck of the perfusion bottle and were connected with two cannulae. During the first part of the experiment both cannulae were tied into the two renal arteries of the two kidneys, the renal vein of each kidney being ligatured and a slit made in each for escape of fluid. During the second part of the experiment the left kidney remained as before as a control but in the right kidney I removed the cannula from the artery (which I cut through) and tied it into the renal vein, so reversing the current. Both ureters were loosened from the peritoneum and their ends (of equal length) were inserted into collecting tubes. Experiment set going at 10 50, both ureters excreting freely. Put 1st pair tubes from 11·30–12·0.

Artery perfusion in both kidneys.

IL = 5·0 c.c. (30 m.) [1 c.c = DCIL]
IR = 2·6 c.c. (30 m.) [1 c.c. = DCIR]

[11·30–12 0 bottle perfused 110 c.c. = 18·3 c c. per 5 minutes.]

At 12·0 I inserted the cannula of the right kidney into the renal vein and ligatured and slit the artery. At 12·15 I restricted the slit in the artery owing to the flow being excessive, and between 12·30 and 1·0 I found that the rate of perfusion was 28 3 c.c. per 5 minutes, i.e. one-third faster than during the first part of the experiment.

Artery perfusion in left kidney; venous perfusion in right kidney.

Between 12·30 and 12 58 I had collected

from left kidney 4·75 c.c. (28 m.) [1 c.c. = DCIIL]
from the right kidney 31·8 c.c. (28 m.) [1 c c. = RCIIR]

Thus the reverse current in the right kidney produced 6·6 times as much[1] urine as the direct current in the left kidney, though in the first part of the experiment, the left kidney excreted nearly twice as much urine as the right (possibly owing to the cannula having a larger orifice).

DCIL = 0·000546 gm. Nitrogen.
DCIR = 0·000373 gm. ,,
DCIIL = 0·000693 gm. ,,
RCIIR (1)[2] = 0·000453 gm. ,,
RCIIR (2)[3] = 0·000546 gm. ,,

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[1] Both kidneys had had all nerve connections severed so that this factor, as regards quantity of urine, was absent. All the renal nerves in the frog experiments, on the other hand, were left intact.

Another objection which may be urged against these experiments on the rabbit is that "failure of absorption from overflooding is especially liable to occur in the rabbit in which absorption is peculiarly ineffective at the best" (17, p. 50). Even allowing for this factor, the excretion of the vein-perfused kidney in these experiments should still have been less instead of more owing to the decreased pressure in the glomeruli, but Cushny quotes an experiment on the rabbit in which, during sulphate diuresis, the two kidneys, perfused via the renal arteries, actually excreted at the rate of 5 c.c. per minute, and even at this rate, according to Cushny, the tubules absorbed 40% of the water passing through the kidneys, i.e. the kidneys excreted 0·26% of sulphate while the serum only contained 0·15%, so that in my experiments absorption should certainly have occurred on the neo-Ludwig view.

[2] First sample taken during the first four minutes.

[3] Second sample taken during the first four minutes.

Thus the left kidney urine in both parts of the experiment was stronger in nitrogen than the right kidney urine, but the two urine strengths were more nearly equal towards the end of the experiment.

EXPERIMENT 2. Male rabbit. The experiment was similar to the last, the temperature of the perfusion bottle however being maintained at 45°C. Experiment set going at 1·40 and put tubes from 2·17–3·30.

Artery perfusion in both kidneys

IL = 7·9 c.c. (73 m.) [1 c.c. = DCIL]
IR = 1·3 c.c. (73 m.) [1 c.c. = DCIR]

[2·15–3·15 bottle perfused 135 c.c. = 11·2 c.c. per 5 minutes.]

At 3·30 I reversed the current in the right kidney.

Artery perfusion in left kidney; venous perfusion in right kidney.

(3·55–4·10, 35 c.c. perfused = 11·6 c.c. per 5 minutes; 4·15–4·45, 73 c.c. perfused = 12·1 c.c. per 5 minutes, so the rate of perfusion in the second part of the experiment was about the same as in the first part.)

Between 4·17 and 4·45 I had collected

from the left kidney 1·5 c.c. (28 m.) [1 c.c. = DCIIL]
from the right kidney 8.5 c.c. (28 m.) [1 c.c. = RCIIR]

Thus the reverse current in the right kidney produced in the second part of the experiment 5·6 times as much urine as the direct current in the left kidney, though in the first part of the experiment the left kidney excreted over 6 times as much urine as the right kidney.

DCIL = 0·000186 gm. Nitrogen.
DCIR = 0·000320 gm. ,,
DCIIL = 0·000226 gm. ,,
RCIIR = 0·000186 gm ,,
1 c.c. perfusing fluid = 0·000213 gm. ,,

Thus the reverse current urine is not much weaker than the direct current urine.

I performed two other experiments similar to the above and with similar results. In one of them the urines of both kidneys with arterial perfusion were exactly equal in strength (0·000320 gm.) and nearly equal in quantity (DCIL = 3·75 c.c.; DCIR = 3·9 c.c.) but DCIIL was as usual stronger (0·000653 gm.) than RCIIR (0·000560 gm.) and both these latter were much stronger than the perfusing fluid (0·000386 gm.). In the other experiment I, at the end of the experiment, filled the perfusion bottle with dissolved indigo-carmine and thus injected both kidneys with dye. The vein-perfused right kidney became dyed deep blue and excreted blue urine immediately the dye entered and in a few seconds both kidney and urine were blue-black; the artery-perfused left kidney and its urine took much longer to become dyed blue—probably owing to the slower perfusion. I subsequently examined sections of these kidneys and made the following report:—

Left artery-perfused kidney. All glomerular capillaries contain dye but no trace of dye in capsules. Large space between inner and outer capsule walls. Dye here and there in intertubular capillaries and in lumina of collecting and convoluted tubules. Lumina of tubules very wide. In certain small areas the nuclei of the convoluted tubule cells were stained blue and numerous blue granules in the cells but in most areas I could detect no dye.

Right vein-perfused kidney. Little or no dye to be seen in the glomerular capillaries but in a few places the capillary epithelium was stained blue, also the nuclei of the outer capsule wall. No trace of dye in capsule cavities. Dye here and there in intertubular capillaries and in tubule lumina. In many areas the nuclei of the convoluted tubule cells were stained blue and the cells contained granules.

I give these facts for what they are worth. The most significant of them are that dye is never to be found in the capsule cavities, where, of all places, according to the glomerular filtration theory, it should be found, and that the areas in which the convoluted tubule cells were stained blue are much greater in the vein-perfused than in the artery perfused kidney.

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11. Concerning a Bon Image.

By Johan van Manen.

It is not generally known that members of the Bon-fraternity may be met in easily accessible places like Darjeeling, Ghoom and various localities in the Darjeeling District. As a rule these representatives of what is commonly called the original religion of Tibet, are men of little learning who can furnish but scant intelligent information about their own beliefs, history and literature. Those of whom I heard, in Ghoom and its neighbourhood, were eking out a precarious existence by the performance of magical ceremonies, mostly amongst the lower classes Yet I am told that really learned Bon-pos exist in Tibet, that there are monasteries of considerable size, and that there is an appreciable printed literature current—not to mention manuscripts—which continues to be published and sold in the Bon-po religious centres. Data furnished on this point by Rockhill and Grenard endorse such statements. What we know of the religion itself is so confusing and incomplete that we must admit that the system is practically as yet a completely sealed book to us. The literature on the subject up till about 1897 has been very completely summarised by B. Laufer in his introduction to his Klu ḥbum bsdus paḥi snying po (Memoirs of the Finno-Ugrian Society, XI, Helsingfors, 1898). From the appearance of that work onwards the most important publications on Bon matters have been the following:—

1. Laufer's work itself.

2. By the same Author: Ein Sühngedicht der Bonpo. Memoirs of the Imp Ac. of Sciences, Vienna, XLVI, 1900.

3. The same: Über ein Tibetisches Geschichtswerk der Bonpo, T'oung-Pao, Second series. Vol. II, No. 1. Leyden, 1901.

4. Sarat Chandra Das, The Tibetan Text of the rGyal Rab Bon Kyi Jung-nas, of which No. 3 is a review and discussion.

Concerning this last publication it is a curious detail that my copy bears the imprint "Calcutta. Bengal Secretariat Book Depot, 1915," whereas Laufer, in 1901, refers to it in the following terms: "*Vor einiger Zeit* übersandte mir der Indische Pandit Sarat Chandra Das den in der Presse von *Darjeeling* hergestellten, 61 Octavseiten umfassenden Abzug eines tibetischen Werkes, das den Titel führt: *rgyal rabs bon gyi ḥbyung gnas.*" Laufer's book and the copy sold by the Calcutta depot seem identical; the bibliographical puzzle involved is immaterial for our present purpose.

5. We may expect that Hastings' Cyclopædia of Religion will soon bring some further valuable matter on this subject, but the references to it will find a place under the heading Tibet, and the volume containing T is not yet out.[1]

6. It may be noted that in Rockhill's edition of Sarat Chandra Das' Journey to Lhasa and Central Tibet, new edition, London, 1904, though it gives on pp. 271–276 some interesting details about the Bon-pos, the editor states on p. 284 in a footnote that he has there left out "several pages of text on the ethics, etc., of the Bonbo, but they are so technical that I have been obliged to omit them." The original edition of S. Ch Das' record is very difficult to obtain or even to consult

7. Lastly, mention may be made of L. de Milloué, Bod-Youl ou Tibet, Paris, 1906, Annales du Musée Guimet, Bibl d' Études, Vol. 12, Ch. VI, Religion, pp 153–162, which contains a summary, mainly based on the data of Sarat Chandra Das, without furnishing essentially new information

So much as to the literature. Three descriptions of Bon deities have been published to my knowledge. The first again by Sarat Chandra Das, in the *J.A.S.B.*, Vol. 50, Part I, No. III. The second in *J.B.T.S.*, Vol I, passim, 1893. It is not expressly stated whether Sarat Chandra Das is also the author of this contribution, but that seems likely. It is richly illustrated, presumably, as to the great majority of the gods represented. from pictorial representations, not images. Yet the data furnished by both pictures and description are confusing and vague, giving little definite information. The third contribution to the subject, first in point of time, is by Hodgson, who gives the pictures of the "chief deities" of the Bonpos in the *J.R.A.S.* for 1861, Vol. 18, p. 396. This volume has not been within my reach as it is lacking in the Imperial Library set and the copy of the Asiatic Society was out on loan every time I asked for it. The reference is taken form Schlagintweit's article Über die Bon-pa Sekte in Tibet, in the proceedings of the R Bavarian Ac. of Sciences, Philos.-Philol. Section, 1866.[2] Hodgson's illustrations were also based on pictures, not on sculptures or other plastic representations. The pictures in the *J.B.T.S.* are exceedingly crude and undistinctive.

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[1] This was written before the last volume, completing the work, had been issued; and the hope was inspired by a cross-reference justifying expectations. Alas, in this, as in some other cases, the monumental work has left us in the lurch and disappointed us. The promised reference to Bonism has materialised as a few superficial lines, altogether inadequate to the subject. This is one of the curious gaps in this uneven book, though one which may be forgiven. But what to think of the omission of an entry 'Nidānas'!

[2] Through the courtesy of the Secretary the volume was recalled for me after I read this paper before the meeting of the Society. The plates

That the Bon-pos possess, however, a rich variety of idols in plastic form is evident from the information quoted by Schlagintweit (*op. cit.*, reprint, p. 9) from the Annales [de la propagation de la foi], Vol. 37.

He writes: "The missionaries found in the monastery they visited, and which had been denuded of its 'Götterschmuckes,' a great number of plastic representations, whilst the walls were covered with frescoes."

Desgodins (Le Thibet, 2e ed., Paris, 1885, p. 202) laments: "The learned Pon bo say indeed that their Kuntu-zang-po (Supreme Spirit) is immaterial, absolutely perfect, and they concede him even a certain eternity during which he created all beings. If they only stopped there, one could, by means of a certain amount of explanation, arrive at some understanding; but then they give their immaterial god a wooden or brass body, in which they make him reside whom they worship."

It is then evident that Bon-po idols must exist, but in the literature I have accessible I have found no authentic description or even mention of any such idol. An exception, perhaps, is Hackin's L'art Tibétain, collection de M. J. Bacot, Paris, 1911, where the last three numbers 316–318 are described as 'Divinité Bon-po' and 'Image Bon-po.' No. 316 is of 'bois peint sculpté, cavalier vêtu à la chinoise'; No. 317 'bois grossièrement sculpté'; No. 318 a central garuḍa surrounded by animal-headed other garuḍas, 'très grossièrement traités,' with an image of Gshen-rab-mi-bo in the upper part. As Bacot's collection numbers over 300 items and only three Bon-po images form part of it, one Chinese in treatment, and the two others of rough workmanship, the inference is that truly Tibetan Bon-po images of good workmanship must be very rare

Grenard, in his Tibet (English translation, London, 1904), which has a valuable paragraph on the Bon religion in chapter IX (Religion), states, on p. 325: "They profess a profound veneration for an idol called Kepang, made of a mere block of

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given do not furnish material throwing much light on the subject discussed here. From the brief accompanying text I quote only the following passage:—

"Bonpa Vihárs are still numerous and wealthy in Tibet. In the Himálaya there is nothing of the sort, nor can the solitary exorcist of this or that rude and unlettered tribe, himself a member of the tribe and ignorant as his fellows, give one word of information as to the origin of his creed," etc.

But Hodgson thinks that "there can be no doubt it is an integral art of Buddhism."

wood dressed in bits of stuff." (Is this Sarat Chandra Das' Pehar ?)

From all the above it will be understood that I felt considerable satisfaction when some time ago a Bon idol was offered to me for sale by its owner, a local Bon "lama" in Ghoom. All the more so as the image was of excellent workmanship and decidedly better than many of the modern Nepalese brasses which are so profusely in evidence in the Darjeeling Bazar shops. As the original owner is himself a Bon-po there is a *prima facie* probability that the image may be authentic and I now give its description together with reproductions of it, giving a front and a back view. I also add some collateral matter connected with Bon problems. What I submit here is the result of extensive inquiries amongst all the Tibetans I consulted as likely to be able to throw light on the matter.

The name of the god was given as གསང་བ་, gsang ba, which seems to mean The Secret One, or, perhaps, the Mystery God, the god of mysticism, though the word in the ordinary language has only the meanings 'secret,' or 'mysticism' as a substantive and 'to secrete' as a verb. As we shall see it seems a Bon equivalent or counterpart of གསང་བདག་, gsang-bdag, an epithet of Phyag-rdor, ཕྱག་རྡོར་, or Vajrapāṇi.

The image is made of brass, exactly 6 inches high, and 5½ inches in width at its widest point, from crown to crown of the two prostrate figures bearing the god. The workmanship is good, though not extremely delicate, and the lines are pure with fairly refined details.

The bottom of the image is closed by a sheet of copper on which a double or crossed dorje, རྡོ་རྗེ་རྒྱ་གྲམ་, is engraved. Probably the hollow foot contains some auspicious material, as usual in Tibetan images. When shaking the image, something rattles inside, perhaps some grains of rice. At the back a small square piece is let in, slightly under half an inch square. This has in all probability served to allow of the insertion either of the "life-tree," སྲོག་ཤིང་, or of a mantra, སྔགས་, which properly consecrates the idol. On a base (པད་གདན་, pad-gdan, lotus-seat), the traditional lotus stool, two figures lie on their backs On them stands the god in a "fierce" form, wide-legged and with arms extended. In the right hand he holds a dorje, with the left one he holds a garuḍa. The body is naked, as shown by navel and breast-nipples, save for a kind of loincloth on which an ornamental pattern is worked. A kind of girdle, difficult to explain, encircles the body well above the abdomen and the hips, or rather, is shown only in front; on the back it is not visible. I believe that it cannot be the rim of a coat of armour which would be an analogy with that of the Lcam-sring or Beg-tshe of Lamaism, but it may be an iconographical remnant of this prototype. See Grünwedel's remarks about the hem or rim of garments indicated on female statues, Buddhistische Kunst in Indien. p. 37. The body is encircled by a huge snake as a garland, but I cannot make out with absolute certainty whether the maker intended to represent two snakes or one, as it is possible to think that the coils are mixed up with a necklace with elaborate breast-pendant. If there are two snakes, one intertwines tail and head on the back of the neck and the other on the left shoulder. I am, however, inclined to think that there is only one snake and that the second coil is rather a double strand belonging to the necklace with large bows on the shoulders. One of my consultants suggests, furthermore, that what I take to be bows of the necklace are in reality the heads of two other snakes. In that case the necklace itself would probably also be a snake, and then there would be three snakes in all. If that were so then the maker would not have continued his details clearly on the back of the image and this incompleteness of detail would be on a par with the absence of the continuation of the girdle, mentioned above, on the back. This would lead us to the very interesting conclusion that we would have to be careful in distinguishing between the iconographical canon and the actual execution of the artist. Four smaller snakes function as ankle rings and wrist bracelets. Round the biceps of each arm there is an ornamental armlet, and, as already mentioned, a necklace with an elaborate pendant hangs round the neck. The two ends of a scarf wound around the hair tuft flow down on either side of the body. The head wears a high coil or knot of hair. In this connection the remarks by Grenard and Rockhill (Diary) may be remembered as to the length of the hair worn by Bon-po lamas. The Nying-ma-pas also wear their hair long when becoming hermits, རི་ཁྲོད་པ་, and Percival Landon mentions in his Lhasa (p. 123 of the one-volume edition, p. 227 of Vol. I in the two-volume edition) that long hair is the mark of the immured Nyen-dé-kyi-buk hermits. (According to oral information this is the name of a monastery, ཉང་སྟོད་སྐྱིད་ཕུག་, the happy caves of upper Nyang.)

On the head there is a diadem bearing five skulls, topped by ornaments, probably representing jewels. The ears have long earrings.

The image is in its natural metal but the hair of both the god and the garuḍa are painted red.

Though the god is of the fierce type his expression is fairly natural and not as hideous as in most Lamaistic 'fierce' gods. He has a third eye, the so-called fierce eye, དྲག་པོའི་མིག་ or hon. སྤྱན་. In addition to the definitions given by Grünwedel, Mythologie des Buddhismus, Leipzic, 1900, p. 100, I am told that the wearing of a skull diadem is also a characteristic indication of the fierce form, as is also the stretching out of the arms and the spreading of the legs.

The two figures lying underfoot deserve special attention. They are not corpses as in some Lamaist chos-skyong images, nor does it seem that they are really being *trampled* on. They are not represented as passive, but rather as actively bearing, upholding, supporting the god on their own bodies. Each of the two figures holds up a heel of the god with one hand, whilst the other hand seems to indicate a mudrā. I do not feel expert in the identification of mudrās; readers may verify the question by looking into it for themselves. Subject to correction it seems to me that the left hand figure, which has the arm flat alongside the length of the body, with the four fingers stretched out and the thumb crossed over the open flat palm of the hand, exhibits the dharmadānamudrā, ཆོས་སྦྱིན་ཕྱག་རྒྱ་, the finger position of religious gifts, the bestowal of religion. The figure to the right holds up the arm at a right angle at the elbow, and joins the thumb and the middle finger, slightly bending the remaining fingers so that the hand is not perfectly flat. This seems the abhaya mudrā, འཇིགས་མེད་ཕྱག་རྒྱ་, the sign or gesture of fearlessness, safety or protection. This is the opinion of some of my Tibetan friends. But some European friends disagree and name the two the vyākhyāna and bharada mudrās. Experts in iconography may perhaps be able to draw conclusions as to the identity of the figures from this detail. It should be considered whether there is a significance in the fact that these mudrās are shown not in front of the figure, but hidden at the back, behind the legs, so that the act of service is evident and the symbol of religious action hidden. The two mudrās seem the same as those in several images of Tārā in my possession. I am told that often the temple gods of modern Hinduism also exhibit these two particular mudrās.

The two figures are naked, save for a loincloth. They may wear earrings, but this cannot be said with certainty for it may be that the lengthening of the ears is meant as in the flesh itself. The hair is done up in a top knot, is otherwise short without tresses, and shows no ornament. This top knot may, however, represent the ushṇīsha. Both figures seem to represent males, and the total absence in either of them of female-breast indication has its value in connection with what follows. Finally, both figures stretch out one leg with a slight bend upwards (not flat) and cross the other leg over it, showing that they are represented as alive. The attitude of the two bearing figures is far more one of adoration, worship and self-humiliation than one of subjection or defeat. It seems less as if the god tramples them down than that they support him with their bodies out of their own free will. One of my consultants describes their attitude as one of veneration, གུས་ཞབས་ཀྱི་སྟོད་སྤྱངས། ।

The whole type of the image is, however, unmistakably that of the Lamaistic chos-skyong or Dharmapāla, and a Lamaist whom I asked whom he thought the image represented answered at once Phyag-rdor, Vajrapāṇi, and then, as a second guess, Hayagrīva, Rta-mgrin, རྟ་མགྲིན་. As remarked before Vajrapāṇi is also called གསང་བདག་, gsang-bdag, the Lord of Mysticism or Secrets, the Secret Lord.

Getty, in The Gods of Northern Buddhism, p. 134, states under Beg-tshe, belonging to the Dharmapāla class:—

"Little is known of the ferocious warrior-god, Beg-tshe, who seems to be confounded by the Northern Buddhists with Hayagrīva, whom some of the sects also call 'Protector of Horses'."

According to Getty, p. 50, Vajrapāṇi has several Dharmapāla forms such as Vajrapāṇi-Âcārya and Acala-Vajrapāṇi, as well as a Garuḍa form.

As to the name གསང་བ་, gsang-ba, I have not been able to trace any authentic and satisfactory quotation illustrating it. Yet Sarat Chandra Das, *J.B.T.S.*, Vol. I, Pt. I, appendix, p. 2, mentions 'the mystic god called Sangspo.' whom Gshen-rab worshipped and through whom he acquired the three kinds of occult powers of Bon mysticism', and in *ibid.*, Pt. II, appendix II, p. 13, he refers to a god 'dPal mgon gsang va lagchen,' who may or may not be the same. In the Rgyal rabs bon gyi ḥbyung gnas, the name seems not to occur. In a little manuscript Bon treatise in my possession, called བསད་ལས་རིན་ཆེན་འཕྲེང་བའི་སྟོད་ལས་, "(Taken) from the beginning of the precious garland of murder," the name is mentioned several times without any further explanation, but in the form of གསང་བ་འདུས་པ་, gsang-ba ḥdus-pa, the united, collective, concentrated, Secret One. Another name occurring in the same book, སྐུ་གསུམ་ཁྲོ་རྒྱལ་ sku-gsum khro-rgyal, Three-body-anger-king, Angry-Trinity king, is said to be a synonym for the same god. S. C. D. mentions, in his dictionary, a Drag-gsum དྲག་གསུམ་, "the three fierce ones (the Bon trinity)."

For the interpretation of the image I was first told the popular version based on the antagonism between the Bon-chos and Lamaism, namely that the two prostrate figures represent the Buddha being trampled underfoot by Gshen-rab, with the explanation that the latter has conquered the former and that the image symbolises the contempt of the Bon-pos for the Buddha and Buddhism. I objected against this that there is only one Buddha but there are two figures in the image and that therefore another explanation must be sought. In this connection we may recall Schlagintweit's description (*loc. cit.*, p. 9) of the god Tam-lha-me-ber (with a reference to the Annales, Vol. 37, p. 415): "His feet trample down human beings, often only two in number, and then Shākyamuni and Padmasambhava."

Later on I had an occasion to discuss the image with my friend the Lama Padmacandra who made several interesting observations concerning it. He, too, holds that the two prostrate figures represent the Buddha and Padmasambhava. In support of this opinion he quotes a significant shloka from the Bon rituals, the invitation or citation of the god, སྤྱན་འདྲེན་, spyan-ḥdren, which runs as follows :—

པད་འབྱུང་ཤཱཀ་ཐུབ་བསྙོལ་བའི་ཁྲི་སྟེང་ནས།
བོན་ལྷ་དབང་དྲག་འབར་བ་གཤེགས་སུ་གསོལ།།

"From the seat formed by the prostrate Padmasambhava. and Shākya Thubpa, We beseech the Bon god Flaming-Fierce-Power to come here."

[སྣོལ་བ, snol-ba, here rather stretched out, lying down, than locked together.]

According to Padmacandra Fierce-Power, or Strong-Fierce, is a name for Tamdin, རྟ་མགྲིན་, or Hayagrīva, and he calls our image a Bon-po Tamdin. Hayagrīva is said to stand on ཁྱབ་འཇུག་, Vishṇu, and དབང་ཕྱུག་, Îshvara or Mahādeva. I append here the following observations all furnished by Padmacandra.

The Bon religion possesses all the gods of the Vajrayāna, རྡོ་རྗེ་ཐེག་པ་, Padmasambhava's "religion," ཆོས་. Moreover, Padmasambhava's reform or mission was in the nature of a compromise between Buddhist and indigenous, བོན་, practices. He left three forms of worship untouched :—

པདྨས་བོན་གྱི་ཆོས་ལུགས་གསུམ་བསྒྲུབས་མ་སོང་།

"Padma did not subdue three Bon practices." These practices are :—

1. ལྷ་གསོལ་བ་, devapūjā, worship of deities, with reference to the gods.

2. གཡང་སྒྲུབ་པ་, siddhikaraṇa, producing success or fortune, with reference to human beings, ourselves.

3. མདོས་གཏོང་བ་, with reference to the demons. For the meaning of mdos see the detailed article *s.v.* in S. C. D's dictionary. A good picture of an exceptionally large mdos is to be found in Customs of the World (London, Hutchinson & Co.), Vol. I, p. 569. The mdos is a kind of artificial spider's web, made of coloured threads, and may be often found near Tibetan habitations, together with rejected torma cakes.

There is also another Bon practice, ཇུ་ཐིག་, ju-thig which, according to the dictionaries, is a drawing of lots by threads of different colours. In Lamaist rituals and worship coloured threads play an important part. Other practices, such as

སྲུང་བ་, protection (by amulets), need further investigation.

There are three forms of Bon worship, བོན་ཆོས་གསུམ་ཡོད། They are :—

1. དཀར་པོ་, white,
2. ནག་པོ་, black,
3. ཁྲ་བོ་, mixed, grey (lit. variegated, piebald, many-coloured)

1. བསྐྱབས་མ་སོང་, unsuppressed.
2. ཐམས་ཅད་བསྐྱབས་སོང་, completely suppressed.
3. ཕྱེད་ཀ་བསྐྱབས་སོང་, half suppressed.

The white and grey varieties are still practised but of the black variety only books are to be found, and the practice is forbidden and made penal.

The preservation of the above three practices is summarised in the saying .—

ལྷ་གཡང་སྐོར་གསུམ་མིན་པ་ཐམས་ཅད་བསྐྱབས།

" Except the three practices connected with the gods and success, all (others) have been suppressed (been put a stop to)."

[སྐོར་, in the above saying, is " concerning," but not the substantive སྐོར་བ་, " circumambulation " or " turning round ", which includes also the turning of the prayer wheel.]

Another saying, embodying a command of King Tisrongde tsan, ཁྲི་སྲོང་ལྡེའུ་བཙན་, alludes to this ·—

བོན་པོ་བསམ་ཡས་མ་ཐོང་ཡུལ་ཕུད་སོང་།

" Let no Bon-po come to (the monastery of) Samye ; let them leave (expel them from) the country."

[སོང་, imperative of འགྲོ་བ = སོང་ཤིག་]

It was mentioned above that the Bon religion possesses all the gods of Padmasambhava's religion. It is even held that the true བོན་པོ་འི་ཆོས་ལུགས་ is essentially the same as

Padmasambhava's Tantrism. I suppose that this statement has to be interpreted in the sense that the compromise effected by Padmasambhava has resulted in mutual concessions and adaptations which make it difficult to say where, in present practice, the purely native and the Buddhistic foreign elements begin and end. So it is said that in the བོན་ཆོས་ there are nine progressive vehicles, ཐེག་པ་རིམ་པ་དགུ་, and that also in the Old Sect, that of the Nying-ma-pas, there are nine successive vehicles : ཆོས་རྙིང་མ་པ་ལ་ཐེག་པ་རིམ་པ་དགུ་ཡོད།

Each ceremony or cho-ga, ཆོ་ག་, is divided, in both religions, into three parts.

1. སྔོན་འགྲོ་, beginning, prologue
2. དངོས་གཞི་, substance, essence, body.
3. རྗེས་ཆོག་, winding up, final, epilogue.

These three divisions are sub-divided under nine heads :

1. སྐྱབས་འགྲོ་, refuge.
2. བྱིན་འབེབས་, blessing, consecration.
3. སྤྱན་འདྲེན་, invitation, citation.
4. མཆོད་པ་ pūjā, worship.
5. བསྟོད་པ་, praise, invocation.
6. བཟླས་པ་, japa, repetition, recitation.
7. བཤགས་པ་, confession.
8. རྫོགས་རིམ་ or བསྐྱེད་རིམ་, meditation.
9. བཀྲ་ཤིས་, maṅgalam, benediction.

These nine together constitute one complete ritual or ceremony, ཆོ་ག་ཆ་ཚང་།

The similarity in terminolgy, doctrines and practices of the two religions is explained as follows. The history of religion in Tibet knows of two periods of religious persecution and eclipse, the ཆོས་བསྣུབས་པའི་དུས་ and the བོན་བསྣུབས་པའི་དུས་. The obscuration period of the (Buddhist) religion was under the reign of Langdarma, གླང་དར་མ་, and the Bon-eclipse was under that of ཁྲི་སྲོང་ལྡེའུ་བཙན་, Tisrongdetsan.

In olden times the kings of Tibet had two ministers (or perhaps this was especially so for Tisrongdetsan and some others), namely a profane minister with nationalistic leanings in religion, a "bad" one, and a (Buddhist) religious one, or "good" one. The bad minister is called བདུད་བློན་, the devil-minister, and Tisrongdetsan's devil-minister was called མ་ཞང་ཁྲོམ་པ་. The good minister is called the ཆོས་བློན་. and the name given for Tisrongdetsan's religious minister is པདྨ་གུང་བཙན་. This is another than the གུང་རི་གུང་བཙན་, Gung ri Gung-btsan, whom S. C. D. in his dictionary mentions as the son and successor of Tisrongdetsan.

During Padmasambhava's first efforts at converting the Tibetans Tisrongdetsan's sympathies hovered at first between the old Bon religion and the new Buddhist doctrine. He at first tried to encourage both and to let them flourish side by side. When, however, Padmasambhava and the "more than a hundred pandits" with him, witnessed the bloody sacrifices of the Bon priests, they threatened to return to India and to cease their endeavours at converting the country if these sacrifices were not stopped. Padmasambhava made it clear to the king that the practice of both religions together in the same country was incompatible with the ethics of Buddhism, and he put the choice before him either to have "one king and one religion" in Tibet, or to let him, Padmasambhava, with his followers, retire. Contests in magic power between the rival parties were an element in the settlement of the question and finally the king gave in to Padmasambhava and embraced Buddhism whilst suppressing the Bon-pos. This was the second period of religious persecution in Tibet, but this time of the old religion of the country, the བོན་བསྣུབས་པའི་དུས་. The Bon-pos fled the country, in so far as they were not killed or forcibly converted, or did not manage to hide their views and practices. They went chiefly to the outskirts of the country; and Amdo (Kham), Byang, བྱང་ཐང་, Kongpo, ཀོང་པོ་, Sikkhim and Bhutan are mentioned as the places where they mostly settled. This is given as the reason why the Bon religion flourishes most on the frontiers of Tibet. It is significant that a similar reason is attributed to the establishment of a seat of learning in Kham, especially Derge, as to Buddhist traditions. The erudition of Derge is ascribed to the emigration of the Buddhists under Langdarma's persecution, and it is said that these early fugitives took with them not only valuable traditions of learning and doctrine but priceless books and images as well.

Very valuable details concerning the second episode, the conversion of Tisrongdetsan and the banishment of the Bon-pos are to be found in chapters 66-68 of the བཀའ་ཐང་གསེར་འཕྲེང་, or in full ཨུ་རྒྱན་གུ་རུ་པདྨ་འབྱུང་གནས་ཀྱི་སྐྱེ་རབས་རྣམ་ཐར་རྒྱས་པར་བཀོད་པ།

In connection with the question of bloody sacrifices, alluded to above, it is worth while to record an interesting tradition, that the name Gshen rab, གཤེན་རབ་, of the Founder of the Bon religion, should mean "the great butcher," the executioner par excellence.

There were, nevertheless, several Tibetans with strong Bon sympathies who remained undetected and who masked their beliefs. They hid the nature of their writings, it is said, by the introduction of Buddhist terminology, and especially བདུད་སྣོན་མ་ཞང་ཁྲོས་པ་, a contemporary of Vairocana, Padmasambhava, and Tisrongdetsan, introduced many Buddhist terms into Bon writings to save them from annihilation. On the other hand, Vairocana, out of a spirit of diplomacy and compromise introduced Bon terms into his own writings, both originals and translations, with a view of making them more readily acceptable to the people of the old belief. He seems to have succeeded in attracting the Bon-pos in this manner to a considerable extent, but the result of both methods has been the exceedingly hybrid nature of the terminology and practices of the present Nyingmapa and Bon literatures and cults. The Lishiḥi gurkhang, ལི་ཤིའི་གུར་ཁང་, mentions a few equations between Bon and "modern" terminology

Nowadays Lamaists consider Gautama as the head of the མདོ་སྡེ་པ་, sautrāntikas, whilst Padmasambhava is looked upon as the head of the གསང་སྔགས་པ་, tāntrikas.

The Bon believers or "Bonists" are called Bon-po, བོན་པོ་. The Bon religion is called Bon chos, བོན་ཆོས་. The Bon way, manner or custom is called the བོན་པོ་འི་ལུགས་སྲོལ་ or Bon lugs, བོན་ལུགས།

Now to come back to our image, from the above it would seem very likely that the two prostrate figures, indeed, represent the Buddha and Padmasambhava Upon further enquiry I obtained, however, the following statement from the old owner of the image, which I print in its original form.

གསང་བ་ཟེར་བ་དེ། སྟོན་པ་གཤེན་རབ་དྲག་པོ་ལ་སྤྲུལ་པ་བཞེས་ནས་རྟ་ཕྱག་ཁྱུང་གསུམ་ཡང་ཟེར་བ་རེད། རྐང་པའི་འོག་ལ་གནན་པ་དེ་བདུད་ནག་པོ་ཕོ་མོ་གཉིས་རེད། བདུད་ནག་ཕོ་མོ་ཟེར་བ་དེ། ང་སྟོན་པ་གཤེན་རབ་ཡིན་ཟེར་ནས། བདུད་ནག་ཕོ་མོ་གཉིས་ཀྱིས་སྟོན་པ་གཤེན་རབ་ཀྱི་ཆོས་སྣུབ་པ་རེད། དེ་ནི་ཁོང་དྲག་པོ་གསུམ་ལ་སྐད་ཅིག་ལ་སྤྲུལ་ནས། བདུད་དེ་གཉིས་རྐང་པའི་འོག་ལ་བརྫིས་པ་རེད། རུ་ཏྲ་ཐར་པ་ནག་པོ་ཡང་ལབ་པ་རེད།

"He who is called the Secret One, after having taken form as the Fierce Teacher Gshen-rab, is also called the Rta-mgrin—Phyag-rdor—Garuḍa Trinity. Those who are trampled under his feet are the male and female Black Devils. These two male and female Black Devils, after having said: "We are the teacher Gshen-rab," destroyed Gshen-rab's doctrine. Then, after having transformed himself instantaneously into the fearful Trinity, he trampled these two Devils under foot These Devils are also called the Black Salvation Rutas (Ru-tra)."

[Lexicographical note. རྟ་ཕྱག་ཁྱུང་གསུམ་ is a བསྡུད་ཚིག་, bsdud tshig, abbreviation, ellipse, for རྟ་མགྲིན། ཕྱག་རྡོར།

བྱ་ཁྱུང་། གསུམ་, the three, or trinity of, Hayagrīva, Vajrapāṇi and Garuḍa.]

That the Garuḍa plays an important part in the Bon teaching is well known, and the kinship of our image with Hayagrīva and Vajrapāṇi is already sufficiently proved by the incident quoted before, of the identification of the Bon god with the two Lamaistic divinities by a Lamaist friend. There is, however, no unmistakable indication that one of the minor figures is intended to represent a female body. Also, artistically, their conception is altogether normally human not demoniacal or mythological at all. Iconographically it is difficult to believe that they either represent the Buddha and Padmasambhava, or even a pair of devils. They are so entirely free from attributes and so naturally modelled that they seem rather symbols of ordinary mankind and nothing more. Whilst it would be possible to represent the Buddha by one of the figures, the peculiar iconographic type of Padmasambhava is so characteristic that we can scarcely expect to meet a Tibetan figure that should represent him without any of the characteristics associated with this type. One detail must be noted, however, because it may prove to furnish a clue to the solution of the problem. The figure to the right has a little circle engraved between the eyebrows, or rather above the nose on the forehead. It is a perfect little circle and does not look like a third eye, oblong The other figure lacks it. One of my informants says that this is the ūrṇā or apāṅga, called in Tibetan མཛོད་སྤུ་, which sends out the marvellous ray of light called མཛོད་སྤུའི་འོད་ཟེར་. See J.'s dictionary under this word. The Tibetan belief is that this is not a circle of hairs, but one single hair curled into a spiral. This mark, my informant holds, indicates that the figure showing it is indeed meant for the Buddha. Padmasambhava would be naturally without it If the circle represents an ordinary tilaka, तिलक, then no inference can be drawn from it as to the sex of the wearer, as both men and women wear tilakas.

Who the Rutas are (རུ་ཏ་, elsewhere written རུ་ཏྲ་), has also to be determined. An obvious guess might suggest the Indian Rudra (Grünwedel, Mythologie, p. 180). Sarat Chandra Das also lets the Rudras play an important part in the Bon hierarchy of superhumans. The important place they occupy in Lamaist tantrism may be learned from Sir John Woodroffe's Shakti and Shakta, or Avalon's Tantrik Texts, Vol. VII, the Shrichakrasambhara. Padmacandra says that རུ་ཏྲ་ཐར་པ་

ནག་པོ་ = སྲིན་པོ་ = rākshasa. We leave this question open for the moment. Cf. Getty (*op. cit.*), p. 65, on this matter, and also S. C. D., Dict , under the various combinations of drag-po, དྲག་པོ།

We have now considered the subject from all sides and have to sum up. Our conclusion is:

that the Bon character of our image is well established,

that the name given to the god, གསང་བ་, is authentic,

that his prototype is the Lamaistic chos skyong, dharmapāla, more especially Vajrapāṇi,

that he is allied to Rta-mgrin and also connected with the Garuḍa,

but that the character of the two figures which support him needs further determination.

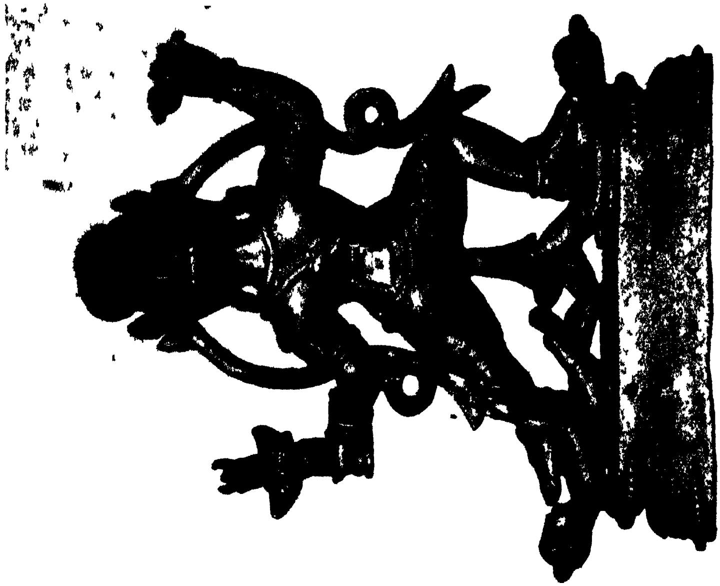
None of the explanations of these figures given above quite tally with their expression as sculptured. Nevertheless, the Bon-po owner's indications cannot be summarily rejected because the legend told by him might, if elaborated and corrected, after all prove to contain a satisfactory solution of the apparent difficulty. Whilst wishing to reserve the Black Salvation Devils as potential helps for obtaining our answer, we are not inclined to reject altogether the theory that the two enigmatic figures may yet be found to represent the two great teachers of Tibetan Buddhism, but we are at the same time far from sure that such an identification is beyond doubt.

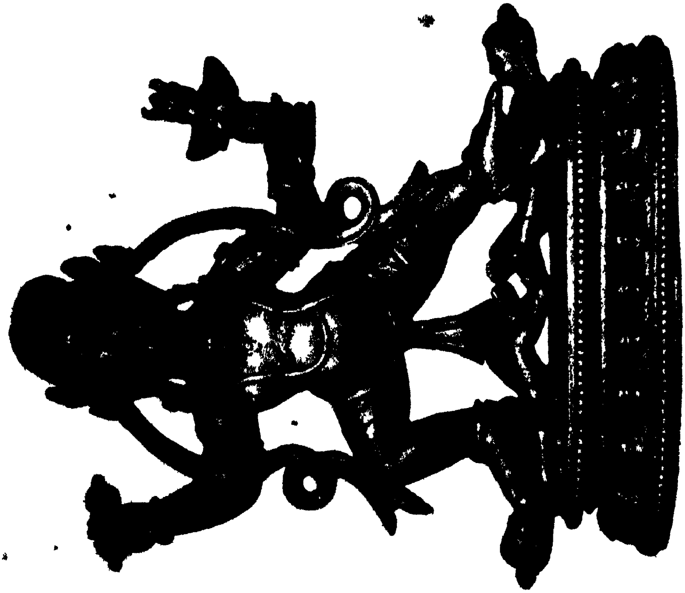
To the above conclusion, however negative it already is, a reservation must be attached. We called the Lamaistic dharmapāla the prototype of our image. This view is only held with reference to this particular personality or his class, as shown by his attributes. A wider and deeper question is raised by the query whether in general the "fierce" forms of the Lamaistic pantheon are original, that is to say, have naturally arisen out of elements inherent in Indian Buddhism, or whether they have arisen under Tibetan influences, that is, whether they are the legacy of Bon traditions left to the conquering faith. In other words, is the "fierce" element in Lamaism essentially Tibetan, or perhaps even generally Mongolian? To answer that question we feel not at all competent, but the enquiry suggested by it seems of great interest. It would surely be worth while to know where we have to look for for the origins of the skulls, blood, skeletons, intoxicating drink, daggers, flames and other "angry" paraphernalia of Lamaism, and incidentally of much, especially is Bengal, connected with the wider subjects of Tantrism, Kālī worship and the like. To me it seems that in Lamaism we find a fusion of two distinct though apparently similar elements, namely Hindu Shivaism and Mongolian Bonism, which for want of a better word may be provisionally called Shamanistic.

In conclusion, having had to say a good deal about Vajrapāṇi, we may incidentally remark that the Rāja of Sikkhim is held to be his incarnation, though Amundsen, Primer of Standard Tibetan, p. 85, states that it is 'the Abbot of Trashilunpo' who is his incarnation.

And now, may god Gsang-ba be lenient to us and forgive the sinner who wrote this.

PLATE VI





12. Pearl Formation in the Indian Pearl Oyster

By James Hornell.

In the following brief note, I do not propose to traverse the past history of the theories and researches upon this subject; the conclusions to which I have come after twenty years' work on this and related problems are sufficiently definite and, I believe, conclusive, in the light of the most recent results obtained by others, to stand by themselves as strictly conformable to the actual facts.

Pearls in the widest sense may be defined as more or less rounded masses of shell substance made up of concentric layers laid down around a nucleus. The shell substance may be of any one of the four layers normally present in such shells as the pearl oyster or two or more of these may alternate in the layers. Some pearls consist wholly of periostracum; these are brown and on account of the lack of lime in their composition, they frequently crack as they yield up moisture. In one example of a periostracal pearl in my possession, half the sphere is coated with nacre; had the process been extended and continued, a complete coating of nacre would have been deposited, converting a valueless pearl into one of considerable price, but of specific gravity less than normal. Periostracal pearls are formed invariably in or close to the edge of the mantle, where are situated the cells normally engaged in the secretion of periostracum Nacreous pearls characterize the pearl oyster, but in molluscs where the inmost layer is porcellanous any pearls produced are themselves porcellanous. examples of these are the well-known pink pearls obtained from the West Indian conch, *Strombus gigas*, the rare and beautifully watered pearls produced by the chank (*Turbinella pirum*) in our own waters, and also the lustreless white pearls sometimes found in the edible oyster Hypostracal pearls are, in my experience, the most numerous of all in the local pearl oyster, but they are usually minute and even microscopic. They were called calcospherules in the Ceylon Pearl Reports. They occur when present in and around the insertion ends of the pallial and adductor muscles, often in great abundance; 'nests' of 20 to 50 are not rare when properly sought for Many of these become the pseudo-nuclei of nacreous seed-pearls, the real nuclei being of course the nuclei of the calcospherules themselves. Not infrequently contiguous pearls of this nature fuse into a compound mass of irregular shape, one form of the baroque pearl, useful to the imaginative jeweller for the production of quaint pearl ornaments One such compound mass I have seen worked into the form of a mulberry fruit, mounted with a spray of golden leaves. Other artists have utilized such masses in the production of grotesque figures when from time to time jewellery of this design is fashionable.

True gem-pearls are those composed of lustrous nacre and of symmetric shape, round or pear-shaped preferably. These are produced normally in the mantle in the region between the pallial line and the limit to which the deposit of nacre extends marginally—from half to three-quarters of an inch inwards from the free edge of the shell. Such pearls seldom occur in the visceral mass area of the mantle or within the muscles. As will be seen later, these gem-pearls have frequently some foreign intrusive body as the nucleus whereas the less valuable pearls found in and around the muscle insertions have some particle produced by the oyster itself, as the centre of deposition.

In all cases an envelope of secreting tissue—the pearl sac—surrounds the developing pearl. In the case of gem-pearls this arises usually as an invagination of the external epithelial layer, for the intrusive foreign body is generally found in the first instance between the inner surface of the shell and the secretory surface of the mantle. The latter being delicate yields readily to the pressure of the intrusive body which then comes to lie in a pit within the mantle substance. At first this pit is wide-mouthed, but as the foreign object sinks deeper in, the mouth of the pit narrows to a neck, and eventually may close ; the next stage is for the cyst containing the intrusive body to separate from its connection with the epithilium and to assume a saccate shape conformable with that of the enclosed body. For this reason, Prof. Herdman and I named pearls of this origin ' cyst pearls ' in contradistinction to the small and usually irregularly shaped ' muscle pearls ' formed within the muscles. This classification has the merit of simplicity and I see no reason to amend it.

Cyst-pearls in number are relatively very scare as compared with muscle pearls, and large cyst pearls, the true gem-pearls, are again relatively much scarcer than small sizes. The former constitute the so-called Orient pearls, pre-eminent above all for their lustre and purity of colour and for a peculiar suggestion of translucency not seen in other pearls.

The origin of these pearls has been a battlefield of theory in the past ; the resultant confusion appears to me to be due in large part to the lack of recognition that there are these two main categories of pearls, differing in origin, and that in the case of cyst-pearls the causative body may and usually does differ with the locality and the species investigated. In the case of certain mussels (*Mytilus edulis*) the causative nucleus has been found in certain beds in France to be a larval trematode worm (Jameson and Boutan), and in certain fresh-water mussels in one locality this is replaced by a little commensal mite (Küchenmeister). In the case of the Ceylon and Indian pearl oyster, Prof. Herdman and the author found it in many cases to consist of the dead body of a larval Cestode. To this we gave the name *Tetrarhynchus unionifactor*, and we correllated it with an advanced larval Tetrarhynchid of typical form found commonly encysted in the walls of the oyster's intestine. At a later date we discovered that the adult of the latter worm is found in the sexually mature condition in the intestine of an oyster-eating ray, *Rhinoptera javanica*. At one time we intercalated an intermediate host, one of the file-fishes (*Balistidae*) but eventually the species found in the file-fishes was found to be of a distinct species, not parasitic in the larval condition in pearl oysters. I have, however, come now to the conclusion that the spherical cestode larva found in abundance in the tissues of the pearl oyster and frequently as a nucleus in cyst pearls from the same mollusc, is not a younger stage of the undoubted Tetrarhynchid larvae encysted in its intestine. Possibly it is the larva of some species of *Tylocephalum* or other closely related genus, but this is a subject for further investigation.

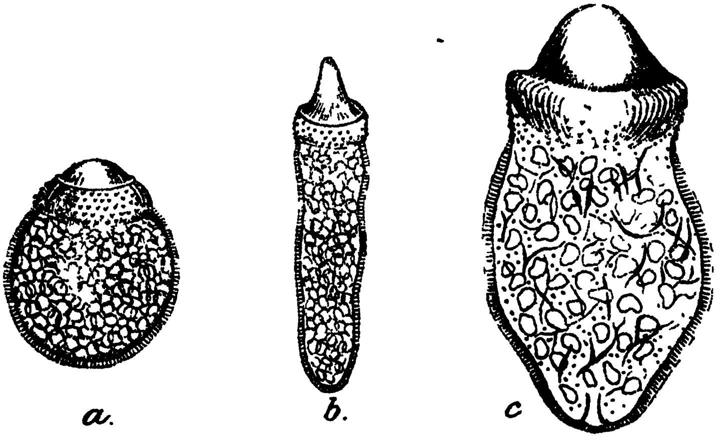


FIG. 1.—Three cestode larvae extracted from cysts found in the tissues of the pearl-oyster (Gulf of Mannar). A. is the youngest stage found ; B. is an elongated form (older) occasionally found, while C , seen under higher magnification and slightly compressed, shows the beginnings of a vascular system and also a terminal excretory pore. Note in all the minutely spinous nature of the collar and the multitude of tiny calcareous granules densely filling the body region

Few pearl oysters are free from this parasite. Usually the gills contain hundreds, often very minute and never differing in any appreciable degree from those shown in figure 1 where three larvae, freed from their cysts and in different stages of growth, are seen in optical section. The digestive gland is another favourite location for these cysts, opalescent white spheres conspicuous in the dark green of the gland. In figure 2 (A. and B.) are drawn two nuclei which I obtained by decalcification of small orient pearls; there can be no question as to their identity with the spherical larvae found alive in the tissues. Neither Prof. Herdman nor I ever claimed that all cyst pearls have such nuclei; we recognized that other foreign bodies,

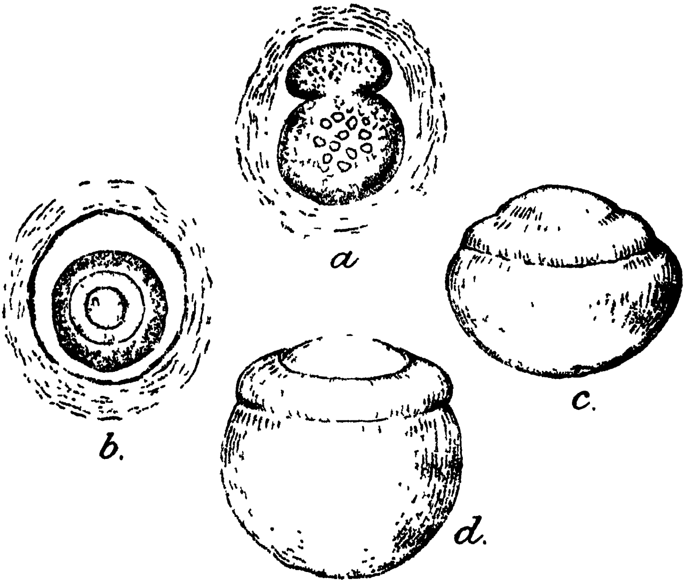


FIG. 2.—A. and B. are two nuclei obtained from Ceylon Orient pearls by decalcification. In each a portion of the inmost conchyolin layers is shown. In A. some of the minute calcareous granules seen in figure 1 are observable, while B. shows the collar and proboscis (face view) of this larva very distinctly. C. is the enlarged appearance of the pearl that yielded nucleus B; note its resemblance in form to the outline of the spherical larva shown in D. (*cf* Fig. 1,A).

notably grains of sand, occasionally function as the intrusive irritating factor and become pearl nuclei. We have also even found a small nematode worm, coiled upon itself, forming the nucleus. So far we went, over 16 years ago. Subsequent investigation shows me that a further qualification is necessary whereby cyst pearls may be divided into two sections, the one comprising pearls induced by the irritation of foreign bodies and the other those with nuclei of periostracal-like substance derived from the oyster's own tissues. The former class comprises according to my investigations, the majority of the larger cyst pearls, the latter of the smaller ones of this description, which, as I have indicated above, constitute by far the larger proportion of cyst pearls. This conclusion to our local researches disposes satisfactorily of certain objections levelled at the cestode theory and places the latter in its proper perspective; we see that cestode larvae though less frequently the cause of pearl formation than was at first believed, are nevertheless the *most important factor in the production of the larger and finer of Orient pearls* and therefore of supreme importance from the economic and commercial viewpoint. Let us now see how pearl formation proceeds (*a*) in cyst pearls formed around intrusive foreign bodies; (*b*) in those with a fragment of periostracum as nucleus, and lastly (*c*) in muscle pearls.

Some of my earliest experiments made in Galle in 1902, have direct and fundamental bearing on this problem. These were in respect of the power of the oyster to repair injuries to the shell. They resulted in demonstrating that epithelial cells are capable. at least over the nacre-secreting area, of an alteration in the character of their secretive power upon emergency. Thus I found that if a fragment of shell in the centre of the valve were removed, exposing the mantle which previously had been engaged in secreting nacre, the first repair substance formed was not nacre, but a yellow parchment-like material apparently identical with periostracum. Only after a stiff layer of this was formed, was there a resumption of nacre secretion. Now in all the pearls I have examined and notably in button pearls formed after the old Chinese method, and within recent years refined and extensively employed on a commercial scale by the Japanese. I have found that the nucleus, whether it be a cestode larva, a grain of sand or a spherule of mother-of-pearl (as in the Japanese culture pearls), is not overlaid directly by a nacreous layer, but has interposed between its surface and the eventual layers of nacre, a distinct and well marked deposit of stiff yellow membrane identical with repair periostracum, which indeed it is. It is evident that the intrusion of any body into the ectoderm must affect it in a similar manner to that caused by a direct injury, such as a fracture of the adjacent shell would do; hence the impulse of the cells around the intrusive body is to pour out the primary secretion employed to meet such an eventuality. The inmost layer of such a pearl is invariably of periostracum. Only after the effects of the shock have passed and normal conditions are restored, does the nacre secretion begin to be again deposited. What seems to me to be the explanation is that the membrane repair substance is really the conchyolin basis of nacre with the lime salts withheld. In other words, after a shock, the epithelial cells intermit the secretion of lime salts, but continue the secretion of conchyolin thus giving a periostracal appearance to what would normally be a nacreous layer (conchyolin + carbonate of lime).

Another deduction which I have made from the investigation, is that only dead or dying parasites excite an irritation of the character necessary to induce pearl formation. A living parasite does not irritate the tissues in the same way; indeed it merely induces the formation of a tough connective tissue sheath or cyst enveloping it wherein it lies quiescent and harmless, giving no further irritation. But in the case of a parasitic larva that arrives in the epithelium in a dying condition, exhausted or perhaps smothered in the secreted fluid poured out by the epithelial cells, a different situation is found. Instead of being within a layer of connective tissue, it lies in a depression of the epithelial layer of cells and these act differently from connective tissue cells—with a correspondingly divergent result.

In regard to the second and more numerous class of cyst pearls usually however much smaller in size than those of the first class, decalcification shows no definite nucleus other than a tiny amorphous scrap of brownish refractive substance, similar apparently to periostracum. Rubbel of Marburg has investigated the origin of pearls with a similar form of nucleus obtained from freshwater mussels. He showed that granules of the same appearance not infrequently appear in the secreting epithelial layer of the mantle. These at times appear to cause an irritation that induces the adjacent cells forthwith to begin the deposit of nacre upon these refractive bodies; later by radial division and multiplication these cells form a minute pearl-sac around each nuclear body, which continues the deposit of concentric layers of nacre and thereby produces a pearl. The same sequence of events occurs in the Indian pearl oyster eventuating as above stated in the production of the majority of cyst pearls found in the mantle. The irritation produced is so slight that no shock is experienced and therefore no periostracal repair substance is deposited prior to the first nacreous layer.

The third class, muscle pearls, remain for consideration. From their place of origin being invariably close to the insertion of muscles attached to the shell and from the columnar nature of their pseudo-nucleus, we may infer that their initial origin is due to the dislodgment of a tiny particle of hypostracum from the insertion surface of the shell, caused by some exceptional strain set up, such as an excessive and sudden contraction of the muscle involved. A particle set loose in this manner causes irritation in the same way that an intrusive foreign body or an unwanted particle of periostracum does and with similar effects: a minute pearl sac is formed, enveloping the particle, which however in this case begins by secreting columnar hypostracum instead of periostracal membrane or of nacre. This is consistent with its natural function. In the nests of these pearls in a very early stage which I have often examined, the columnar structure is extremely clearly shown; in optical section each pearl is seen as an oval body made up of lines radiating from an almost imperceptible nucleus of the same refractive index. The pearl sacs of adjacent pearls are very prone to coalesce both in this early stage, the calcospherule stage as Prof. Herdman and I named it originally and at a later date when of larger size. In this way irregular pearls are formed. Usually only one concentric layer of hypostracum is laid down, but more may, rarely, be deposited. As a rule the next layers laid down are composed of nacre, and in this way the pearl finally assumes the normal appearance of a pearl, at least of one of inferior quality. Owing to the crowding together of these pearls as happens normally, mutual pressure adversely affects their shape. Frequently they are found partially coalesced, as twin pearls; more usually they are irregular and mishapen in varying degree. They constitute the bulk of the seed pearls put upon the market.

Very vigorously grown adult oysters, particularly those of exceptional size, are prone to form nests of these muscle pearls. This is exactly what we would expect reasoning from the facts stated above. In oysters of this description, the strength of the muscle fibres is exceptionally great and as a consequence dislodgment of tiny particles of the hypostracal layer to which they are attached and disturbance of the cells secreting this substance are more frequent than in smaller and weaker oysters, where muscular force is distinctly weaker.

13. An Automatic "make and break" Key for Actuating the Heating and High Potential Circuits of a Coolidge X Ray Tube.

By E. P. Harrison, Ph.D., F.R.S.E., F.Inst.P.

and

Narendra Nath Sen.

In using a Coolidge tube for operations (such as photography of a Lane diffraction pattern) in which the tube has to be "run" for considerable periods with currents greater than 3 milliampere and during which the anticathode may become seriously overheated it is convenient to allow the tube short periods of rest for cooling To effect automatic "make" and "break" of the three circuits (heating interruptor and coil-primary) the apparatus described below has been devised. By its use it is possible to run a Coolidge tube carrying a heavy current without attention for an indefinitely long time and with no risk of overheating.

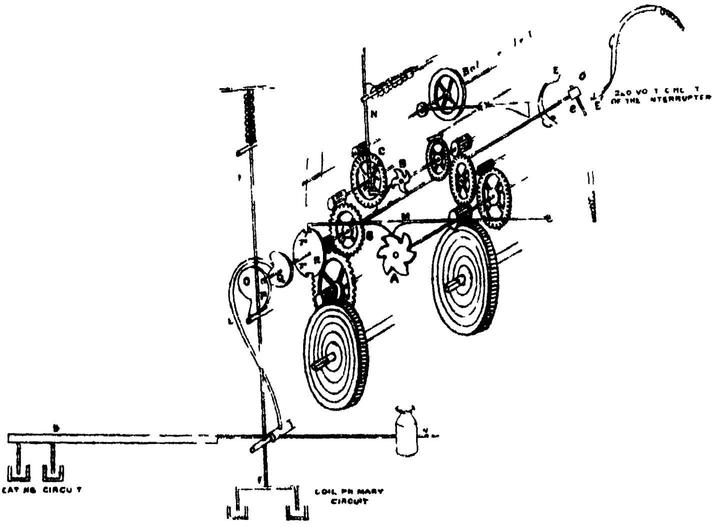


Fig. 1.

Suppose it is desired to run the tube for 5 minutes, then cool it for 10 minutes; run it for 5 minutes, once more cool it for 10 minutes. and so on.

The problem resolves itself into—

(1) "Making" the 3 circuits in the correct order with an interval of (say) 5 seconds between each "make."
(2) Keeping the circuits "made" for 5 minutes (1st stationary state).
(3) "Breaking" the 3 circuits in the reverse order.
(4) Keeping them "broken" for 10 minutes (2nd stationary state).

An American clock (Fig. 1) with an alarm system is employed to actuate the various keys. The axis 00′ (which is the axis of the striking system in the clock) and all wheels and cams on it (P, Q, R, S, e) remains stopped or can be rotated by the clock: if free to rotate 00′ makes one revolution in a few seconds, during which,

(i) Excentric cam Q actuates a lever L which depresses D into its mercury cups and "makes" the heating circuit;
(ii) The contact piece e makes brush contacts at E thus completing momentarily a relay circuit (Fig. 3) which "makes" the 220 volt circuit containing the mercury interruptor;
(iii) Excentric cam P actuates a plunger F which "makes" the coil primary circuit and starts the tube.

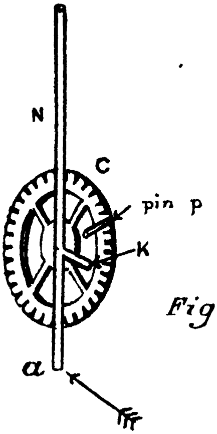


Fig. 2.

According to the angular adjustment on the axis of the two cams P and Q and the contact piece e the order of the above operations is determined. The order of contacts is actually that described above.

The process by which the motion of the axis 00′ is started and stopped so as to produce 5 seconds intervals between the 3 contacts and 5 and 10 minute stationary states, is as follows:—

The axis 00′ is set in motion by a double release system:—

(i) by the lever M disengaging from the slots r or r′ on the wheel R, in which case the axis is free to rotate through 180° unless prevented by;
(ii) the catch N which engages with a pin on the wheel C and stops the motion of 00′ even if M is raised. (Figs. 1 and 2).

Suppose now that stationary state II is just over and it is necessary to 'make" the circuits.

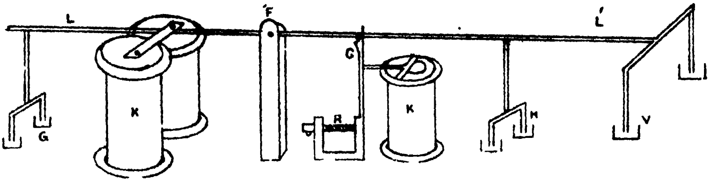
∴ The following operations occur :—

The lever M is raised by one of the teeth on the wheel A (minute-hand axis, period 1 hour). The axis OO′ is however still held in check by the catch N[1]; 5 seconds afterwards, under the influence of the teeth of the wheel B (period 20 seconds) N releases C and allows rotation of the axis through 60°; then re-engages with C[2] and stops the motion; after another 5 seconds a new tooth in B causes N to release C again, allowing a further rotation of 60° and no more.

After still another 5 second interval N releases C a third time, allowing a third rotation of 60° and no more.

At this stage after rotation of 3 × 60° = 180° the lever M descends into the slot r′ and stops the axis for 5 minutes. For this stoppage to occur at the right moment, A must be correctly adjusted on its axis.

Fig. 3.



The 3 connections D, E and F all being "made" the Coolidge "runs" for 5 minutes. At the end of 5 minutes M again rises and catch N actuated by B proceeds to permit three 60° revolutions as before, during which, the cam P *raises* F and breaks the coil primary; the contact piece e actuates the relay (Fig. 3) and breaks the 220 volt circuit; the cam "Q" breaks the heating circuit.

As before there are 5 second intervals between the three operations.

Finally, M descends into slot r again and stops the motion for 10 minutes.

The circuits are now all "off" and the Coolidge cools.

The process is then repeated automatically.

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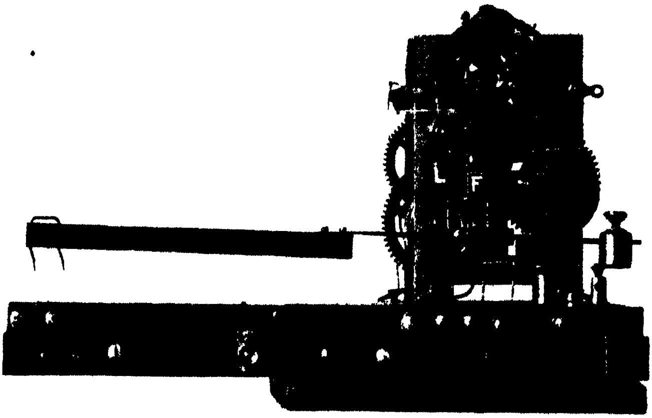
[1] See Fig. 2. The catch K rigidly attached to N is pushed aside by B (shown in fig. 1) actuating the arm a in the direction of the arrow parallel to the plane of the wheel C, thus releasing K from the pin p (on C) and permitting C to rotate

[2] To do this K comes back into position and again engages with the stop-pin p.

The following points are worthy of notice :—

1. Since the heating circuit of the Coolidge is in connection with the secondary circuit of the coil, the cells, ammeter and resistances used in the heating circuit are necessarily insulated from the earth.

Consequently the heating circuit mercury cups D must be insulated from the clock itself and must in addition, be separated from the nearest conductor on the clock by an insulator of length not less than the maximum alternative spark gap used with the coil. To this end, the arm which carries D is made of ebonite and is about 8″ long. See Fig. 4.



2. The wheel B revolves once in 15 seconds. Its energy is small and it is inadequate of itself to stop the motion of the axis 00′ by engaging direct with the wheel S. Hence the necessity for making the catch N, actuated by B engage first with a wheel C which in turn engages with S, thus increasing the mechanical advantage of B.

3. The periods to be adopted for the 2 stationary states, which periods depend on the conditions under which the Coolidge is required to work, can be altered by altering the arrangement of the teeth on the wheels A and B. Wheels of various type can be prepared and put on as required.

14. Dates of the Votive Inscriptions on the Stūpas at Sāñchī.

By R. C. MAJUMDAR, *Dacca.*

The chronological classification of the ancient monuments of India has of late engaged the attention of oriental scholars. Sir John Marshall who has gone into this branch of study somewhat deeply has arrived at more or less definite conclusions regarding the dates of various monuments and "traced the history of early Indian art step by step through the first four centuries of its evolution." His theory is based on 'a serious critical analysis of the sculptures carved upon these monuments" and he has "used their style and technique as criteria to determine their date." It appears Sir John Marshall did not rest satisfied with this line of evidence alone but realised 'the necessity of working out the dates of the ancient monuments of India also from palaeographic indications" With this object in view he initiated an enquiry into the subject and evidently chose Mr. Rama Prasad Chanda, B.A, to undertake the work. It may be at once said that the realisation of the importance of an enquiry on the above line and the selection of the scholar to undertake the work alike reflect great credit upon the scholarship of Sir John Marshall.

Mr. Chanda undertook the work in right earnest and the results achieved by him are embodied in a beautiful memoir published as the first number of the "Memoirs of the Archæological Survey of India" The net conclusions arrived at by Mr. Chanda, so far as we are concerned with them here, may be presented in his own words.

'To sum up, the Brāhmī inscriptions from the third century B.C. to the second century A D., may be chronologically arranged in the following order :—

1. Edicts of Aśoka.
2. Nāgārjunī Hill cave insciiptions of Aśoka's grandson Daśaratha.
3. Besnagar Garuḍa pillar inscriptions.
4. (*a*) Inscriptions on the railings of Stūpa I at Sāñchī.
    (*b*) Inscriptions on the railings of Stūpa II at Sāñchī.
    (*c*) Bharhut railing inscriptions.
    (*d*) Inscriptions on the remnants of the old Bodh-Gayā railing.
5. (*a*) Besnagar Garuḍa pillar inscription of the year 12

after the installation of the *mahārāja* Bhāgavata.

(*b*) Inscription of Nāyanikā, widow of the Andhra king Sātakaṇi I in the Nānāghāt cave.

(*c*) Bharhut *toraṇa* (gateway) inscription.

6. Hāthigumphā inscription of Khāravēla king of Kaliṅga.
7. Sāñchī *toraṇa* inscriptions.
8. Inscriptions of the time of Śōḍāsa.
9. Inscriptions of the time of Kanishka." (pp 14–15)

It may be remarked here that although four classes of inscriptions are included under No. 4 it is clear from the body of the text (p. 4), that the author looks upon each of them as earlier than the one following it. The Sāñchī *toraṇa* inscriptions thus occupy the tenth place in the chronological series and are referred to by the author to "the first rather than the second century B.C" (p. 7) Mr. Chanda winds up the summary of his results by the following remarks: "The conclusions arrived at above as to the relative ages of these early monuments would perhaps carry conviction enough if they were based on considerations of palaeography alone; but when we find that they are borne out by another and wholly independent line of evidence, then the conviction of their correctness becomes almost a certainty." He then points out in detail how the conclusions of Sir John Marshall, based on an examination of the style and technique of sculptures, are in substantial agreement with those propounded by him.

The striking agreement of the results achieved by inquiries on different and wholly independent lines of evidence is no doubt a gratifying circumstance and goes a long way towards establishing the substantial correctness of both; but before accepting this point of view it is necessary to submit the working out of each independent line of evidence to a rigorous critical examination. It is the object of the present paper to attempt such a scrutiny into the particular line of evidence chosen by Mr. Chanda.

In the first place, the definiteness and the completeness of the scheme suggests an element of doubt about its accuracy. Mr. Chanda distinguishes nine or ten distinct stages of development, marked by pronounced differences of greater or less degree, in the system of Indian alphabet that was in use from the latter part of Asoka's reign to the first century B.C., or in about a century and a half. This would mean that in about fifteen years' time on an average, the alphabetic system underwent a definite change in those days,—a conclusion which seems to be well-nigh impossible even on general considerations, but the weakness of which may be demonstrated also by concrete examples. For, calculating on the same basis, we are entitled to expect at least six distinct stages of alphabetical development in the series of inscriptions which begin in the third year of Kanishka and terminate in the year 99 of his era. For there cannot be any valid ground for the supposition that changes in the alphabet took place at much longer intervals immediately or shortly after the Sāñchī *toraṇas* were erected than was the case before. The fallacy may be similarly demonstrated by taking into consideration the inscriptions of any other period of Indian history. The situation is rendered still more complex by another consideration. Mr. Chanda himself recognises the fact that the differences in the inscriptions on the railings of Stūpa I and Stūpa II at Sāñchī are comparatively very slight and that "the latter may be somewhat later than the former." He even puts the two under one general chronological division. Yet he sets down the interval between the two as that of one generation (p. 4) which can by no means be considered to have been less than twenty-five years. According to his own views, therefore, the differences between the broad chronological divisions must be considerably more than twenty-five years each. But leaving aside the fourth group which, with its four sub-divisions, comprised about one hundred years on the above calculation, there remains a period of only fifty years or a little over that, for accommodating the six broad chronological divisions mentioned by him. It thus appears to be difficult to reconcile the different views put forward by the author and one can only hope that he will satisfactorily explain his position. In any case these considerations seem to suggest grave doubts about the correctness of the fundamental principles underlying Mr Chanda's work and the impression gains ground that there is something wrong in his basic assumptions, an impression which I regret to say, is strengthened rather than weakened by a detailed examination of the work to which we next proceed.

There is a preliminary difficulty in any detailed examination of Mr. Chanda's theory, which I think must be stated at the outset. Mr. Chanda has not utilised the brilliant opportunity he had, thanks to Sir John Marshall, of making a chart of all the different types of letters used in the Sāñchī Inscriptions on the lines laid down by Bühler. In the absence of the facsimile of all the inscriptions, this alone would have enabled his readers to judge for themselves the whole palaeographic question in general, and the correctness of his own views in particular. Instead of doing that Mr. Chanda has given us merely the facsimiles of a few typical examples. It is needless to point out that the typical examples chosen by an author labour under the same defects as the eye copy of an inscription; for, in both, the author is prepossessed by his own views about the matter. Thus his plates of the Sāñchī Inscriptions contain merely the facsimiles of those inscriptions which are written in what he chooses to call the "regular monumental type." He seems entirely to omit others which abound in earlier forms, e.g. the inscription on the middle pillar of the additional rail attached to the eastern gate. As he himself admits that "in palaeographic inquiry the most difficult part is the selection not only of the test letters, but of the test froms,—the regular contemporary monumental forms" (p. 14), we may be excused if, in this matter, we refuse to take on trust the views of any scholar, however great, without having an opportunity of judging things for ourselves. Mr. Chanda expresses the very laudable desire that the plates in his book are "intended to help students to draw their own conclusions," but as they are selected on a particular hypothesis, they are of little value from that point of view In short, the plan he has followed seems to be defective, inasmuch as it does not place before the readers all the materials necessary for an independent judgment of the whole problem or of the particular views put forward in the book. With these prefatory remarks we proceed to examine Mr. Chanda's theory in detail.

In order to prove the priority of the first three groups of inscriptions to those of the Sāñchī railing Mr. Chanda has made a comparison of the four test letters *a*, *bha*, *na* and *ha* (p. 2). Following his method we consider them one by one.

I. Regarding the shape of the letter *a* Mr. Chanda remarks:—'This angle formed by the two arms of *a* meeting at a point on the vertical line is the characteristic of almost all the *a*s and *ā*s in the edicts of Aśoka, and *a*s and *ā*s with arms that do not meet, but leave a little intervening space on the vertical line (as in line 5 of the Sāñchī pillar edict, *Ep. Ind.*, Vol. II, plate facing p 369) are exceptional" (p. 2). This does not seem to be a correct statement of facts. Even a cursory examination of the published facsimiles of the Asoka inscriptions would convince anybody that "the angle formed by the two arms of *a* meeting at a point on the vertical line" is not the "characteristic of almost all the *a*s and *ā*s in the edicts of Aśoka." Leaving aside minor varieties, at least five of which were distinguished by Bühler, there are three types of *a* met with in Asoka's edicts, viz the two noticed by Mr. Chanda, and a third in which the arms meet at a point which is at a short distance to the left of the vertical and joined to it by a short horizontal line. Now, a general examination of the records shows that each of these types occurs pretty frequently, and none of them can be said to be the characteristic *a* or *ā* in the edict of Asoka With a view to ascertain the proportions in which they occur in the edicts of Asoka, we have analysed all the *a*s and *ā*s in the Girṇār version of the Fourteen Rock Edicts We find that there are forty-six examples of the first type, in which the arms meet on the vertical line, forty-four examples of the second type in which the arms do not meet but leave a little intervening space on the vertical line, fifty examples of the third type in which the two arms meet at a point to the left of the vertical line and joined to the latter by a short horizontal stroke, and there is one example of a minor variety. This analysis makes it difficult for us to accept Mr. Chanda's views that the first type is the characteristic of almost all the *as* and *ās* in the edicts of Asoka and that the second type is exceptional. It is equally difficult to accept his statement that "in the Nāgārjunī Hill Cave inscription of Daśaratha the arms of all the *as* and *ās* make a sharp angle on the vertical line." It is quite clear even from the blurred facsimile given in Plate I of his *Memoir* that some, if not most, of the *as* and *ās* belong to the third type (cf. e.g. *a* in *anaṁtaliyaṁ* in No. II, l. 2. *ā* in *ānaṁtaliyaṁ* in No III, l. 2, and *a* in *abhishitenā* in No. III, l. 2).

It is thus quite clear that the first type of *a* cannot be looked upon as the regular momumental type either in the time of Asoka or in that of his grandson, and that as such it cannot be taken as a test letter to denote the age of the epigraphs. The same conclusion is also forced upon us when we remember that this type of *a* was in use throughout the period Mr. Chanda has passed in review and occurs not only in the Sāñchī inscriptions but also in the inscriptions of the time of Śoḍāsa and the Kushanas. (Cf. e.g. *a* in (1), *achā* plate IV, No. 2, l. 1; (2) *āchariya* and *arahaṁta*. *Ep Ind.*, Vol. II, p 396. No. 377, ll. 2, 4. (3) *amohiniye āyavati* and *arahata* in plate VI, No 6, ll. 3–4. (3) *araha Ep. Ind*, Vol II. p 386 No. VI l. 2. Mr. Chanda has noticed the occurrence of this type in the Sāñchī inscriptions and has explained it away as archaic, but he has not referred to its continued use till the time of the Kushanas.

It may be argued that although the first type was known throughout the period, it was more in use in Asoka's time than in any subsequent period, and as such its presence in greater or less degree may be taken as an indication of the priority or posterity of the epigraphs in which it occurs Mr. Chanda himself, throughout his work, lays great stress upon this principle. Evidently he does not care so much whether a particular form of letter was generally known in one period or not, but his only concern is whether it was most in use. This follows quite clearly from his arguments in the case of the other two test letters *bha* and *ra*. He admits that the types of these letters which are most in use in the Sāñchī Inscriptions are also to be found in the Asokan records, but as they occur but rarely in the latter they are looked upon as decidedly of earlier date than the former. Now let us test this principle by a concrete example. As has been already shown above, the third type of *a* occurs most frequently in the Girnār records of Asoka and so far as I can see this also holds true of the

Asokan records in general. Now this is the type mostly to be found in all decidedly later inscriptions, such as those of Śoḍāsa, the Kushanas, the Andhras, the Western Kshatrapas, etc., and the later the period almost exclusive becomes its use. But it is the second type of *a* that is used exclusively in the inscription of Heliodorus and almost exclusively in the Sāñchī and Bharhut inscriptions. Now if the greater or less frequency of a type, which is mostly found in a decidedly later inscriptions, is looked upon as indication of later or earlier age, the Heliodorus inscription together with the Sāñchī and Bharhut inscriptions must be looked upon as earlier in point of time than the records of Asoka!

Now there can be no question that at the time when the Heliodorus inscription was composed all the types of *a* were known,—for this is conclusively proved by the fact that they were all used in later times. And yet the engraver selected only one of them to the exclusion of the other two. This proves, if proofs were necessary, that the greater or less frequency of the different forms of a letter which were all fairly in use at a particular period does not necessarily indicate an earlier or later age,—I use the expression 'fairly in use' for the stray occurrence of an irregular form which may possess some affinity to a much later type does not at all count in this consideration. Mr. Chanda has not, however, kept this point in view in selecting *ra* and *bha* as test letters. Thus the type of *bha* which is mostly to be found in Asokan records also occurs in the Sāñchī inscriptions, and. reversely, the type mostly to be found in the Sāñchī inscriptions also occurs in the Asokan records. Both the types were thus known to the engravers of the two series of inscriptions and no necessary indication of age is furnished by the fact that one of the types predominates more in one series than in another.

Similar arguments apply to the third test letter *ra*. The corkscrew type of *ra* which he holds as a test of early age, and the presence of which in the inscription of Heliodorus marks it, in his opinion, as earlier than the Sāñchī inscriptions, occurs also in the Bodh-Gaya railing to which he assigns a considerably later date, on the strength of other tests. This is a serious inconsistency and goes a long way towards proving that the particular type of *ra* cannot be used as a test of age.

It may be noted in this connection that the dagger-shaped *ka* which is exclusively met with in all decidedly later inscriptions including those of the Kshatrapas and the Kushanas occur in the inscriptions of Heliodorus as well as those of Asoka, but are practically absent from those at Sāñchī which preserve only the regular monumental form of *ka* used in Asoka inscriptions. Thus the line of argument by applying which in the case of *ra* Mr. Chanda places Heliodorus' inscription before the

Sāñchī group, would, when applied to *ka* lead to a diametrically opposite conclusion.

As regards the fourth test letter *ha* Mr. Chanda himself admits that the Sāñchī type of *ha* occurs pretty frequently in the Asokan records but that it is found almost exclusively in some of the pillar edicts. " But," remarks Mr. Chanda, " if *ha* is derived from the Aramaic *He* turned upside down and from right to left, the first type of *ha* should be considered as more archaic. In the Nāgārjunī hill cave inscriptions of Daśaratha all the *has* are of this archaic type. So the total absence of this type of *ha* in the older votive inscriptions of Sāñchī, as in other decidedly post-Mauryan inscriptions is not without chronological significance ". Mr. Chanda has also advanced similar arguments in order to prove the antiquity of the first type of *a*. But speculations on this line are of no use, as the derivation of the Brāhmī alphabet from the Phoenician, far less the derivation of the individual Brāhmī character from those of the Phoenician alphabet, as suggested by Bühler, are far from being conclusively proved as yet. Quite recently the theory has been vigorously challenged by Prof. D. R. Bhandarkar and he has produced facts and figures which go a great way towards demolishing it.

There is, however, a strange inconsistency in the above argument If all the *has* in the inscription of Daśaratha are of archaic type, it must, on the principle adopted by Mr. Chanda, be looked upon as earlier in date than even the Asoka inscriptions wherein the *has* of the later type occur as frequently as the earlier!

The above discussions will make it quite clear that *a*. *bha*, *ra*, and *ha* are not really test letters, or, in other words, the forms of these letters found in Sāñchī inscriptions do not lead to any definite inference regarding their age. As Mr. Chanda has based the chronological divisions of the first four groups of inscriptions solely on the basis of these tests this part of his theory requires, in my opinion, further evidence before it can be accepted even as a working hypothesis

It is indeed difficult to form any opinion on the age of the letters of the Sāñchī inscriptions till the estampage of the whole series is available for comparison But if an opinion can be hazarded on the accessible materials, there does not seem to be any valid reason for rejecting the views of Cunningham and Bühler that the inscriptions on the railing belong approximately to the *age of Asoka* ; for so far as I can see, the facsimiles published by Mr. Chanda do not contain any *sure* trace of a *distinctly developed* stage of alphabet.

Let me be not misunderstood. I do not mean to suggest that the Sāñchī inscriptions were incised during the reign of Asoka or even within ten or fifteen years after its close, but that they were engraved at a time when the Brāhmī alphabet had not yet reached its next definite stage of development. It is always a difficult task to determine the duration of one alphabetic epoch—if one might use the term—and it might be anything like a hundred to a hundred and fifty years, or even more.

In the absence of other evidence, therefore, the Sāñchī inscriptions might have been roughly assigned to the period 250 to about 100 B.C., but a comparison with the inscription of Heliodorus seems to carry back this lower limit

This inscription seems to usher in the next stage of development in the Brāhmī alphabet. It shows distinctly the beginnings of the principal characteristics of the later period in the advanced forms of individual letters as well as in a marked tendency towards the angularisation of the letters and the equalisation of their verticals. Cf. e.g. *v* in *dēva* (1. I), *vadhamānasa* (1. 7), and *s* in *vā*(*sudē*)*vasa* (1. 1) *Diyasa* (1. 3), *dasēṁna* (1. 7) ; angular *h* in *mahārājasa* (1. 4), *Hēliōdōrēṇa* (1. 2) ; and the equalisation of the verticals of *s* in *put*(*r*)*asa* (1. 6), and *trātārasa* (1. 6).

The presence of so many decidedly later characteristics in a short record of seven lines marks it as belonging to a later epoch. It is true that the beginnings of the tendency towards angularisation and the equalisation of the verticals are just perceptible in a few inscriptions from the railings of Stūpa I and II at Sāñchī and also possibly in those of Asoka. (Cf e.g. *h* in No. 4, pl III; *s* in Nos. 6 and 8, pl. IV; Bühler's Table II, Col V. 39, and Col. VI. 40.) But a comparison of these letters with those of Heliodorus' inscription referred to above would at once reveal the fact that the forms in the latter are far more advanced. This fact together with the other advanced forms such as the triangular *v* and angular *s*, which are practically absent in the former group, point to the Heliodorus' inscription as marking a new stage in the development of the Brāhmī alphabet. If it is ultimately proved, when the impressions of the whole series of the Sāñchī inscriptions are available for comparison, that all these characteristics are altogether absent from them, it would follow that the original construction of the railing[1] was separated by a pretty long interval from Heliodorus' inscription, an interval which can be hardly set down as less than fifty years, considering the long series of inscriptions that were engraved therein. As Antialcidas must be referred to the latter half of the second century B.C., the railings of Stūpa I at Sāñchī can hardly be brought down to any date later than 200-150 B.C In any case with the evidence available at present, it does not seem possible to come to any other conclusion.

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[1] The massive Stūpas like those at Sāñchī and Bharhut were constructed, as the short donative inscriptions conclusively prove, by the co-operation of a number of individuals. Now the different individuals could either contribute in kind by supplying the parts of the building over which their names are engraved or they could pay an amount of money sufficient to cover the expenses of building them. The symmetry of the different parts of the building is, however, incompatible with the first view, and makes it almost certain that although the donors refer to their gifts of the different parts of the building, they really paid their cost. This again, could have been done in two ways:—(i) by collecting subscriptions for the structures and engraving, as soon as they were completed, the names of the subscribers over the different parts selected

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with reference to the amount they paid; (ii) By first erecting them and then asking the public to contribute towards the expenses in the shape of paying the costs of their different parts which could be easily calculated in this case. It seems, however, to be almost certain that the first method was not adopted, for, in that case we would find the names of donors engraved on a symmetrical plan at the same time by the same individual scribe or scribes. Even a cursory examination of the varying positions of the inscriptions and the different varieties of the characters in which they were engraved would show that this was far from being the case. It must be assumed, therefore, that the second method was adopted. Funds were probably advanced by some public body and the amount was afterwards realised from pilgrims or other individuals who thought it virtuous to contribute towards the expenses of these holy edifices, and who had the right of engraving their own names as donors of particular parts of the whole structure if the amount of money paid by them would be sufficient to cover their cost. According to this method it would naturally take a number of years to realise the whole amount, and it may be, that the whole amount could never be realised at all—a fact testified to by the absence of the donors' name in many parts. An indirect result of this process would be the want of symmetery in the inscriptions, and the use of a variety of types therein; for the engravings would then be a matter, more or less, of private concern, and extend over a pretty long period with uncertain intervals, so as to make it impossible for any central body to adopt a definite scheme for recording the names of donors If we believe that this method was followed in building such structures we must be prepared to accept the view that the inscriptions over them might extend over a pretty long period during the interval between the first donor and the last. It is not even beyond the range of probability that this period might witness some changes in the progressive development of alphabetic form. In judging therefore, of the age of the railing at Sāñchī Stūpa, for example, we should be guided by the more archaic characters rather than the more advanced forms which might have been engraved on the railing long after it was constructed. In any case the presence of advanced forms in one or two inscriptions should not be allowed to modify the view about the date of the building which may be formed by a careful consideration of the generality of the inscriptions.

15. A Note on the Diplopterous Wasps in the Collection of the Indian Museum.

By CEDRIC DOVER and H. SRINIVASA RAO.

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In the present paper descriptions of seven new forms of Vespidae, and new records of the majority of the species of diplopterous wasps described by Bingham in his first volume on the Hymenoptera in the "Fauna of British India" series are given. Some of the species of which new locality records are given here have been identified by the late Col. C. T. Bingham and Mr. C. A. Paiva.

Valuable notes on the taxonomy of the Vespidae are given by Dr. J Bequaert in his memoir on the Vespidae of the Belgian Congo, published in *Bull. Amer. Mus. Nat. Hist.* Vol. XXXIX, 1918. In this paper reasons are given for reducing the genus *Rygchium* (= *Rhynchium*) to a sub-genus of *Odynerus* and for changing the well-known name *Icaria* to *Ropalidia*. The name *Ischnogaster* is also changed to *Stenogaster*, but without comment. After a study of the literature we find that this change should be maintained, for the text of Duperrey's *Voyage de la Coquille, Zoology*, Vol II, in which *Ischnogaster fulgipennis* is described on p. 269, though dated 1830 on the title-page was clearly published after this, the publication probably lasting several years It seems evident that the pages containing the descriptions of the Hymenoptera were published between the years 1836 and 1838 (as Guérin quotes a work published by Lepeletier in 1836), but the Atlas was published long before this. In a foot-note to p. 271 of the text Guérin himself says that plates IX and X, on which *I. fulgipennis* is figured, were published in December, 1831. The generic name of *fulgipennis* was here given as *Stenogaster* and this therefore establishes its validity. In the text the author changed the name *Stenogaster* to *Ischnogaster* as he believed it to be pre-occupied in Coleoptera, but this was apparently a misapprehension, for according to Agassiz' *Nomenclator Zoologicus* the Coleopterous genus *Stenogaster* was described in 1833, and Guérin's genus was certainly prior to this. It will be seen that we have, therefore, no option but to adopt the change from the well-known *Ischnogaster* to *Stenogaster*, but we consider the case (like that of *Icaria*) yet another instance of the unfortunate changes sometimes necessitated by a strict appliance of priority rules [1]

In Dr Bequaert's paper (pp 12–17) a new classification of the diplopterous wasps is proposed. We are of opinion that it is more satisfactory than previous systems and have therefore adopted it here

In the preparation of this note we have received much help from Mr. G. R. Dutt of Pusa who looked over the rough manuscript and suggested certain emendations and also added some notes based on specimens in the Pusa collection. To him our sincere thanks are due.

Family VESPIDAE.

Subfamily ZETHINAE.

Zethus dolosus Bing.

Sikkim; Pashok, Darjeeling District

Labus humbertianus Sauss.

Kangra Valley; Sikkim; Kobo, Abor country, 400 ft. (*S. W. Kemp*, 3·xiii·11); Mergui, L. Burma.

Subfamily EUMENINAE.

Eumenes quadrispinosa Sauss.

Nilgiri Hills, 2,500 ft. (*H. E. Andrewes*, vi·10). Represented in the Pusa collection from Maymyo, Burma, 3,500 ft (viii 14) and Margherita, Assam (19·v·20).

Eumenes architectus Smith.

Sikkim: Sukna, base of E. Himalayas, 500 ft (*N. Annandale*, 1·vi·08); Sadiya, N.E. Assam; Calcutta; Mergui and Dawna Hills, Tenasserim. We have specimens under the name *E. rufipes* Ritsema, which is undoubtedly the same as this species, from Bangalore, Poona and Calcutta.

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[1] The synonymy of the genus is as follows:—

Genus Stenogaster Guérin Méneville.

1831. *Stenogaster* Guérin in *Duperrey's Voy. de la Coq. Ins.*, pl. ix, fig. 9.
1838. *Ischnogaster* Guérin in *Duperrey's Voy. de la Coq. Ins.* II, pt. 2, p. 269.
1853. *Ischnogaster* Sauss., *Mon. Guep. Sociales*, p. 6, pl. ii, fig. 1a–1f.
1897. *Ischnogaster* Bing., *Faun. Brit. Ind. Hym.*, I, p. 376.
1904. *Ischnogaster* Dalla Torre, in Wytsman's *Genera Insectorum, Vespidae*, p. 83, pl. 6, fig. 4.

Type: *Stenogaster fulgipennis* Guérin.
Range: Australian and Oriental regions.

Eumenes affinisima Sauss.

Mussorie, 7,000 ft. (*E. Brunetti*, 20–26·v 07); Simla Hills, 9,000 ft (*N. Annandale* and *S. W. Kemp*, 18–21·vi 06); Rajshahi, E. Bengal (*N. Annandale*, 1-6·ii·07).

Eumenes punctata Sauss.

This is apparently a common insect in Sikkim. Dudgeon's *E. subtestacea* (? MS. only), the type of which is in the Indian Museum, is undoubtedly a synonym of this species.

Eumenes maxillosus var *circinalis* Fabr.

Perak, Malay Peninsula.

Eumenes maxillosus var. *petiolatus* Fabr.

Widely distributed in the Oriental region, extending to Australia. Bingham remarks that the form does not extend to the hills above 2,000 feet, but from specimens in the Museum collection we see that it has been taken at considerably higher altitudes. In the Pusa collection there are specimens from Naduvatam, Nilgiris, 7,000 ft. (v·04); Santikoppa, North Coorg (v. 14).

Eumenes maxillosus var *dimidiatipennis* Sauss

This is a fairly common Oriental and N. African wasp. Cretin (*Journ. Bomb. Nat. Hist. Soc* XIV, p. 820) gives some interesting notes on the habits of this form. The above three forms were regarded as distinct species by Bingham, but Bequaert has recently shown[1] that they are really varieties of *E. maxillosus*, which is a common and widely distributed African species.

Eumenes caffer var. *esuriens* Fabr.

This is a common Indian wasp which has been taken also in N. Africa and Queensland.

Eumenes caffer var. *gracilis* Sauss.

This form has a somewhat similar distribution to the previous one, but Mr. G. R. Dutt tells us that it is a very rare species in collections. After fifteen years study of the Hymenoptera, during which time he has assiduously collected himself and examined the collections of some thorough collectors, he was not able to find more than two specimens. In the Museum there are twelve specimens; two from Tibet, one from Samarang, and the remainder from Singapore and Yokohama. This and the above form were also regarded by Bingham as distinct species, but we have followed Bequaert in placing them as varieties of *E caffer*, a species which does not occur in India.

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[1] *Bull. Amer Mus. Nat. Hist.* XXXIX, pp..856-69, 1918.

Eumenes conica Fabr.

This widely distributed Eumenid is one of the few Indian species of the family whose habits are well known. Notes have been published by Bingham in *Journ. Bomb. Nat. Hist Soc.*, XII, p. 538, and Ramakrishna Aiyar, *ibid*, p. 243. A good account is given by Dutt in *Mem. Dept. Agri. Ind. Ent.* Series IV, p. 231 (1913). Paiva records an aberration of this species in *Journ. Asiat. Soc. Beng.* (n.s.) II, p. 349 (1906).

Eumenes edwardsii Sauss.

Sikkim; Satara District, Bombay Presidency; Calcutta; Kumdhik, Nepal Terai. Represented in the Pusa collection from Pusa (vi·07); Gorakhpur (xii·08) and Trichinopoly (G. R. Dutt "bred from solitary mud cells attached to grass blades; the shape of a cell is roundly oval and it is 14 mm. along the major axis and about 10 mm. along the minor one").

Eumenes flavopicta Blanch.

Bangalore; Nilgiris, 9,000 ft.; Satara District; Khempsa, W. Ghats; Nedumangad, 10 miles N.E. of Trivandrum (*N. Annandale*, 14·xi·08); Cacara Bay, Portugese India (*S. W. Kemp*, 15 ix·16). In the Pusa collection from Matheran, 2 500 ft. Bombay (iv·08); Kannirode, Madras (vi·17); Coorg; Sidapur; Sudaganga and Matale, Ceylon (iii·19).

Eumenes arcuata Fab.

According to Bingham this species does not extend up the Himalayas to any great height, but there is a specimen in the Pusa collection from Lebong, 5,000 ft. collected in September, 1908.

"In September, 1914, Mr. T. Bainbrigge Fletcher found a nest of this species at Moulmein (Burma), which was made of mud, round the stem of a creeper, the nest hanging like a fruit. The mud used was reddish yellow in colour. The nest measured 2½ inches in length and about ⅞ to an inch in breadth and almost round tubular in shape. There were in all eleven cells in the nest. The cells were arranged across the breadth of the nest in pairs, only one at one end was single. In all ten wasps emerged up to 9th October, 1914, seven through circular openings made on one side and three on the opposite side. The eleventh cell was opened in August, 1915, and was found to contain a dead pupa." (*G. R. Dutt*).

Eumenes lepeletieri var. *asinus* Sauss.

This form[1] is not recorded in the "Fauna." The Museum possesses an example identified by Major Nurse and taken by him in April, 1901, in Deesa, a cantonment in the Bombay Presidency. Bequaert considers *asinus* a variety of *E. lepeletieri* which is widely distributed in the Ethiopian region, while the form under consideration was previously known only from Senegal.

Montezumia burmanica Bing.

Sikkim. Meade Waldo has shown[2] that Cameron's *M. bisulcata* from the Khasi Hills is a synonym of this species.

Odynerus (*Rygchium*) *abdominalis* Bing.

Sikkim; Karachi; Bilaspur, Central Provinces (viii·07); Lyallpur, Punjab (xx·21); "*Rhynchium*" as a separate genus will, we think, have to be abandoned as it merges so astonishingly with *Odynerus* that it is best considered as a subgenus of that genus. Mr. Bequaert is also of this opinion. (cf. pp. 120–122.)

Odynerus (*Rygchium*) *nitidulum* Fabr.

Calcutta; Pusa; Bangalore; Lucknow; Kashmir; Lahore, Punjab (iv·08, *Pusa coll.*).

Odynerus (*Rygchium*) *metallicum* Sauss.

Represented in the Pusa collection from Pusa; Bhilsa, C.P. (iv·08); Surat, Bombay (v·04); Lyallpur (ix·21); Burnihat, Assam, 800 ft. (x·20).

Odynerus punctum Fabr.

Calcutta; Siliguri; Purneah District; Lucknow.

Odynerus miniatus Sauss.

Meade-Waldo has shown[3] that Smith's *Pterochilus pulchellus* described by Bingham in the "Fauna" volume on wasps and bees is the same as this species. The Museum has examples from Sikkim.

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[1] Cf. *Mon. Guep. Soc.* 1852, p. 59, pl. xi, fig. 1, and Bequaert, *loc cit.*, p. 277.

[2] *Ann. Mag. Nat. Hist.* (8) V, p. 47 (1910).

[3] *Ann. Mag Nat Hist.* (8) V, p. 101 (1910).

Odynerus diffinis Sauss.

Dhikala, Garhwal District (*R. Hodgart*, 9 v·09).

Odynerus guttatus Smith.

Calcutta; Bangalore.

Subfamily STENOGASTRINAE.

Stenogaster fraterna Bing.

Perak, Malay Peninsula; 10 miles south of Kuching. Sarawak, Borneo (*C. W. Beebe*, 25·vi·10).

Stenogaster scitula Bing.

Sikkim; Pashok, Darjiling District, 2 000 ft. (*L. Hartless*, 11·v·16); Sinla, Darjiling District, 1,500 ft. (*Carmichael Collection*).

Stenogaster scitula var. *assamensis* nov

This is a colour variety of *S. scitula* differing in that it has a dagger-shaped ochraceous marking, not a small central yellow spot on the clypeus; there is a small ochraceous spot on each side of the scutellum anteriorly; and a roughly triangular ochraceous marking on the sides below the wings.

Habitat: Margherita, Assam (*Doherty*).

There are three specimens of this variety in the collection of the Zoological Survey and Mr. Dutt informs us that there is another example from the Murphulani Tea-Estate, Assam in the Pusa collection. Along with this specimen two others were captured which differ from our *assamensis* only in the absence of the scutellular ochraceous markings.

Stenogaster sarawakensis sp. nov.

A small blackish species.

Female: Head finely granular; an indistinct median carina on frons. Clypeus more or less flat, nearly pentagonal anteriorly carinate down the middle, sparsely punctured, a roughly U-shaped ochraceous mark on it, silvery and golden pile on the margins extending to eye-incisions; flagellum rufous beneath, piceous above, and scape fulvous below and infuscate above.

Pronotum reddish on anterior and posterior margins.

Mesonotum finely and closely punctured giving it a finely granulated and striated appearance in different lights, a prominent median carina anteriorly, and a characteristic semi-circular groove transversely about the middle continued forwards and outwards to the anterior lateral margin. Scutellum almost impunctaet, a triangular reddish mark on the anterior lateral margins. Post-scutellum impunctate, a posteriorly emarginate reddish band. Median segment finely obliquely striate, a distinct median furrow and two small, more or less triangular, reddish marks on each side of it at apex.

Abdomen uniformly shining black.

Legs brownish, from the femora outwards with golden pubescence; outer side of coxae of first pair ochraceous, and three-fourths of femora. tibiae and tarsi ochraceous; coxae of second and third pairs with an ochraceous marking on outer-side, and extremities of femora ochraceous.

Wings semi-hyaline, iridescent; stigma brownish-black; an ovate spot on sides below base of forewings, a lunate marking below this, and a spot below hindwings, reddish.

Length : 14 mm. ; expanse : 21 mm.

Habitat : 10 miles south of Kuching, Sarawak, Borneo (*C. W. Beebe*, 20·vi·10).

Type in the collection of the Zoological Survey of India, Indian Museum, Calcutta.

This species is allied to *S. rufomaculata* Bingham, but in our species the mesonotum is grooved and the abdomen is immaculate, while in Bingham's species the mesonotum is not grooved and the abdomen has yellow markings similar to those of *S. micans* Sauss. Mr. Dutt has reminded us that the reddish colour of the markings of our type may probably be due to discolouration by the action of Cyanide. If this is so the original colour was probably ochraceous.

Stenogaster nigrifrons Smith.

Sikkim; Margherita, Assam; Pashok, Darjiling District, 2,000 ft. (*F. H. Gravely*, 26·v·14) ; Tenasserim ; Mergui, L. Burma ; Hills near Taiping, Perak, Malay Peninsula (*N. Annandale*, 26–30·xii 15) ; Penang. There are two specimens from Calcutta (*C. Dover*, xi·20) one of which has the band on the base of the third abdominal segment rather broader than usual and uninterrupted in the middle, and in the other there are two ochraceous spots on the anterior lateral margins of the median segment; the markings on the thorax are also somewhat more conspicuous. We assign these specimens to the above species.

Stenogaster eximia Bing.

Kandy, Ceylon (*F. H. Gravely*, 13·v·10 and iv·10).

Stenogaster eximioides sp. nov.

A deep, brownish-black species.

Male: Head with very fine pale pubescence; vertex rather finely punctured; face to a little beyond the antennae yellow; a distinct median groove extending from the anterior ocellus to a little beyond the antennae; eye incisions yellow. Clypeus yellow, closely pubescent; long, somewhat convex; a prominent median carina anteriorly. Antennae brownish; scape and tip almost yellowish brown. Pronotum with a broad yellow stripe, posteriorly narrowed to a point at base of forewings. Mesonotum closely punctured and very finely granular. Scutellum distinctly convex, pubescent; a prominent median carina and two large semi-circular yellow spots on each side of the carina anteriorly. Postscutellum finely punctured, pubescent; a broad medially sinuated yellow band. Median segment sparsely punctured; a vertically impressed median line; a broad, yellow, longitudinal band on each side.

Petiole of abdomen ferrugineous-brown, blackish at base and apex; rest of abdomen blackish; a yellow semi-circular band on base of second segment; remaining segments similarly but less conspicuously marked; abdomen with pale, golden pubescence.

Legs brownish; femora, tibiae and tarsi of first pair yellow on outer sides; pubescence on tarsi more abundant than other joints.

Wings flavo-hyaline; forewings somewhat dark along costal margin; a small yellow marking on tegulae; a yellow spot on sides below wings, and a lunate spot of the same colour below this.

Length: about 19 mm.; expanse: 32 mm.

Habitat: Nadgani, Nilgiri Hills. 2,500 ft. (*H. E. Andrewes*, iv·10); forest tramway, 10 to 14 miles, 0 = 300 ft., Cochin State (*F. H. Gravely*, 28·ix·14).

Type in the collection of the Zoological Survey of India, Indian Museum. Calcutta. Described from three specimens.

This species is likely to be confused with *S. eximia* Bingham, but it differs in that the yellow markings on the scutellum are large and semi-circular, the median segment has a vertically impressed median line, and the petiole of the abdomen is blackish at the base and apex, whereas in *S. eximia* the scutellum has a pair of small, circular, yellow spots, the median segment is without a vertically impressed median line, and the petiole of the abdomen is unicolourous

Stenogaster bicarinata sp. nov.

A black species.

Male: Head finely punctured; a groove from anterior ocellus to the raised inter-antennal space; a semi-lunate yellow spot just above antennae, and two large, circular, yellow spots below; eye-incisions yellow; two circular yellow spots on vertex behind eyes. Clypeus sparsely punctured with rich silvery pile; pentagonal, long, slightly convex, apical portion elongate and acutely pointed. Mandibles dark-brown, base somewhat yellowish. Antennae dark-brown; underside of flagellum lighter.

Pronotum very finely punctured; a small elongate, yellow marking on the sides anteriorly and a medially interrupted large yellow stripe posteriorly; a small shining, rounded tubercle on lateral margin. Mesonotum comparatively coarsely punctured; two median, parallel ridges anteriorly; a distinct groove on each side commencing from posterior margin and extending to a little beyond the tegulae; a yellow marking between tegulae. Scutellum very sparsely punctate, more or less triangular in section; a yellow marking on each side anteriorly. Post-scutellum almost impunctate; a pair of sausage-shaped yellow markings anteriorly. Median segment impunctate; a distinct median groove; pubescent along outer margins; two elongate. semi-lunate yellow markings extending posteriorly to sides.

Abdomen shining black; finely and somewhat sparsely punctate; thinly palely pubescent; a circular ochraceous marking on each side of second segment; at base a narrow, medially interrupted, ochraceous marking; and two distinct, parallel, elongate, ochraceous markings ventrally.

Legs brownish; coxae yellow on outer sides; underside of femora yellow; covered with pale golden-yellow pubescence which is abundant on tibiae and tarsi of first pair. slightly less so on second and third pairs.

Wings semi-hyaline; nervures brownish, darker along costal margin; stigma dark-brown; a minute yellow spot on tegulae; a large spot below forewings, a lunate marking below this, and a small spot under hindwings, yellow.

Length: 21 mm.; expanse: 18 mm.

Habitat: Ten miles south of Kuching, Sarawak, Borneo (*C. W. Beebe*, 25·vi·10).

Type in the collection of the Zoological Survey of India, Indian Museum, Calcutta.

Subfamily Epiponinae.

Polybia orientalis Sauss.

Sikkim; E. Himalayas from 500–5,000 ft.; Kumaon, 4,000-5,000 ft.; Margherita, the Lushai Hills and Yambung, 1,000 ft. Assam; Lower Burma; Hong-Kong. Represented in the Pusa collection from Maymyo, U. Burma (viii·14); Khasi

Hills (iii·09), Barapani, 3,100 ft. (vi·18), Gauhati (x·11) and Margherita and Lebong, 5,000 ft. (x·08). E. Himalayas. A variable species described by Cameron under various names.[1]

Polybia stigma Smith.

Sikkim; Pashok, Darjiling District, 2,500 ft.; Rangoon; Perak; Dawna Hills, L. Burma, 400–3,000 ft.; Hills near Taiping, Perak.

Subfamily ROPALIDINAE.

Ropalidia ferruginea Fabr.

Bengal; Orissa; N.W. India; Karachi; Portuguese India; Pusa, Bihar; Akru, Bengal; Minba, Burma; Coimbatore; Travancore; Poona, Surat, and Ahmedabad in the Bombay Presidency (Pusa coll.) A widely distributed species. Cameron describes the male in *Ann. Mag. Nat. Hist.* VI. p. 495, 1900.

Ropalidia marginata Lepel.

Sikkim; Margherita, Sadiya, and Shillong, Assam; Ramnad, S.E. India; Bombay: Hoshangabad, C.P.; Bassein Fort (x·09), Surat, Nadiad. Ahmedabad and Poona in Bombay: Coimbatore (Pusa coll.).

Ropalidia variegata Smith.

Sikkim; Siliguri; Calcutta; Allahabad: Simla Hills: Nepal; L. Burma: Ceylon; Java; Andaman Islands. It is also widely distributed in Assam.

Ropalidia gravelyi sp nov.

A blackish species.

Female: Head coarsely and closely punctured, with sparse pale golden pubescence. Clypeus broader than long roughly pentagonal, obtusely rounded apically, somewhat convex; anterior margin ciliated, black; sides and anterior margin ochraceous; posterior margin sinuate. Mandibles dark-brown a yellow spot at base, three large teeth and one small one. Inter-antennal space raised, carinate down the middle; a large reddish spot on frons above antennae; eyes not deeply incised; a reddish stripe alongside inner orbits extending to eye-incisions; a similar stripe behind eyes. Antennae brownish above, ochraceous below, scape somewhat lighter.

Pronotum somewhat coarsely granular; anterior half

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[1] Cf. Meade-Waldo, *Ann. Mag. Nat. Hist.* (8) XIV, p. 406, 1914.

dark, and posterior reddish with a dark marking on inner angle. Mesonotum closely and coarsely punctured; a distinct median groove anteriorly; a short slightly curved groove close to each tegula. Scutellum roughly rectangular, broader than long, punctate and immaculate. Post-scutellum less closely punctate; a pale yellow band on posterior margin. Median segment convex with a median, shallow excavation; distinctly grooved and obliquely striate; a pale yellow, pubescent, circular spot on each side posteriorly close to median excavation: pale silvery pubescence posteriorly and on sides.

Abdomen dark-brown: petiole with a broad shelf-like projection at the posterior margin. Second segment rather distinctly punctured, with fine pale yellow pubescence; a transverse yellow band on posterior margin; two large more or less circular, reddish ochraceous spots, and a transverse ochraceous band on posterior margins.

Apex of coxa of first pair of legs yellowish below; trochanters and femora dark; tibiae and tarsi brown; covered with pale silvery pubescence all over. Coxae of second and third pairs with an oval yellow marking on sides; femora dark with ochraceous patches above; trochanters dark; tibiae and tarsi dark-brown above and lighter below, and closely pubescent.

Wings hyaline, iridescent; costal margin, stigma, and a small circular spot near apex fuscous.

Length: 9 mm.; expanse: 17 mm.

Habitat: Kavalai, Cochin State, 1,000-3,000 ft. (*F. H. Gravely*).

Type in the collection of the Zoological Survey of India, Indian Museum, Calcutta.

Dr. Gravely also obtained two nests together with larvae in various stages of development, and pupae. The nests are small and of a dark-brown colour; one is roughly circular, the other elongate; the stalk is short and attached excentrically. Each cell is hexagonal and the larva lies in it head uppermost.

The smallest larva is about 3 × 2 millimeters the largest 8 × 3 millimeters. They are of a dirty cream colour; head brown, more or less pentagonal, obliquely finely striate with a pale longitudinal median line extending from the vertex to the anterior margin of the clypeus. Clypeus approximately as broad as long, finely transversely striate Body stout, more or less cylindrical in general appearance, but square in section, slightly flattened below, gradually tapering towards anus; the first three segments in the form of deep folds, narrower than the rest; a median groove on dorsal surface First visible segment below broad, more chitinised than the rest, with minute, black spinules. No legs.

The pupae are about 9 mm. long, and enclosed in the pupal skin. General colour yellowish or cream. Head yellowish brown; vertex with a median pale yellow line extending on to clypeus. Clypeus convex, roughly pentagonal, anterior end acute, yellow, with a pale band on anterior margin and a median whitish line. Mandibles yellowish with four sharp denticulations. Eyes dark-brown; ocelli elongated, anterior vertical and lateral oblique. Antennae pale yellow, arched near eyes. Pronotum with thickened posterior margin. Mesonotum roughly pentagonal, anterior margin rounded; a pale yellow median line, and an elongated median, yellowish-brown marking continued anteriorly to the lateral margins.

Scutellum, post-scutellum, median segment, and abdomen yellowish; paler below: median segment excavated medially. Legs pale yellow, folded close to the body; tarsi of third pair extending beyond second segment.

This is apparently a variable species. In an individual from the same nest we have noticed that the clypeus is reddish ochraceous except the anterior margin which is yellow, and that there are two central, black, uniform markings. The species differs markedly. in colouration especially, from any other species that we know.

Ropalidia krishna sp. nov.

An almost uniformly black species.

Female: Head punctured. Clypeus with a few, very fine, scattered punctures; pentagonal, convex; posterior margin slightly sinuate, apex produced into a blunt tooth; a yellow band on anterior margin, and ciliated with ferrugineous hairs; sides covered with pale silvery pile. Mandibles with a yellow spot at base Inter-antennal space raised, with an indistinct grove from this to anterior ocellus; eye-incisions not deep. Antennae uniformly blackish.

Pronotum, mesonotum, scutellum, post-scutellum, and median segment closely punctured and granular; an indistinct; carina anteriorly on mesonotum; a distinct carina on scutellum median segment divided by deep median groove; each half convex.

Petiole of abdomen, and second segment closely punctured and granular; remaining segments less so and covered with fine silvery pubescence.

Legs uniformly black with very fine, pale pubescence.

Forewings flavous; apical half with the exception of a small spot at tip, and costal margin dark-brown.

Length: 9 mm.; expanse: 22 mm.

Habitat: Calcutta and environs (*C. Dover*, xi·20).

Type in the collection of the Zoological Survey of India, Indian Museum, Calcutta.

Its uniform black colour, except for the yellow marking on the clypeus, and its small size make this a distinct species.

Paraicaria bicolor Grib.

Margherita, Assam; L. Burma.

Subfamily POLISTINAE.

Polistes schach Fabr.

Sikkim; Kumaon; Kashmir; Nepal Terai.

Polistes sulcatus Smith.

Tibet; Shillong, Assam; Kashmir; Nepal; Batavia, Java.

Polistes tenebricosus Lepel. var.

This form [1] is not noticed in the "Fauna." It is represented in the Indian Museum collection from Sikkim, Dehra Dun, and various localities in Assam, where it seems to be a fairly common insect.

Polistes sagittarius Sauss.

Probably distributed throughout India and Burma extending to the Malayan sub-region and China. It is mainly a hill species.

Polistes stigma Fabr.

Widely distributed in India, Burma and Ceylon extending to Malaya. This species generally builds its delicate paper combs on trees overhanging a river or a pond. On the island of Barkuda in the Chilka Lake it nests along the shore, chiefly on the southern end, but never in the interior. In a visit paid to Barkuda in the middle of April, 1922, several individuals of this form were seen hovering just a few inches above the mud at the edge of a small pond that has been dug on the island. They would, not infrequently, venture out further and sip at the water.

Polistes maculipennis Sauss.

This is almost entirely a hill species. Sikkim; Mussorie; Simla Hills; Kumaon; Nepal; Kashmir. It also occurs in South Africa. Three specimens in the Museum collection named *P. marginalis shaitan* Bingham are remarkably similar to this species.

Polistes adustus Bing.

Sikkim; Darjiling District from 400–6,000 ft.; Kumaon; Nepal

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[1] Cf. Sauss. *Mon. Guep. Soc.* p. 51, 1853.

Polistes dawnae sp. nov.

A black species.

Female: Head rather closely punctured with very close silvery pubescence. Clypeus approximately as broad as long, strongly convex; posterior margin sinuate; sparsely punctate, covered with close silvery pile; anterior margin obtusely angled with a few golden hairs; an ochraceous stripe along inner orbits, and another on vertex behind eyes; inter-antennal space raised and tuberculate Antennae uniformly black; scape shining; flagellum with very fine cinereous pubescence.

Pronotum with an ochraceous ridge on posterior margin; posterior-lateral margins closely punctured. Mesonotum more closely punctured than head; a short longitudinal grove alongside tegulae. Scutellum less closely punctured than mesonotum; a distinct median carina anteriorly. Post-scutellum narrow, triangular, almost impunctate; two transverse, yellowish, elongate markings anteriorly. Median segment flattened with a deep, median furrow: distinctly transversely striate; a large yellowish marking on each half; closely pubescent on sides.

Abdomen pruinose; basal segment transversely sulcated across the middle; yellow, excepting a black almost triangular mark at the base, vertex of the triangle reaching about the middle of the segment; an ochraceous narrow band along the apical margin and sides of the second segment; apical margins of fourth, fifth and sixth segments faintly testaceous.

Legs blackish with fine silvery pubescence; sides of tibiae with an ochraceous line.

Wings hyaline, brownish yellow along the costal margin; radial cell slightly fuscous.

Length: 10·mm.; expanse: 21 mm.

Habitat: Dawna Hills, 2,000–3,000 ft., L. Burma. (*N. Annandale*, 2·iii·09).

Type in the collection of the Zoological Survey of Indian Museum, Calcutta. Near *P. adustus* Bingham. but distinct.

Subfamily VESPINAE

Vespa dorylloides Sauss.

Widely distributed and fairly common in the E. Himalayas, in Assam, Burma, Borneo and Sumatra It has also been taken on the N.E. Frontier, in Dehra Dun, Saharanpur, the Malay Peninsula and Java. Mr. T. Bainbrigge Fletcher tells us that this species flies by night and is often attracted to light.

Vespa ducalis Smith.

Sikkim; Nepal; U. Burma. Also common in Assam.

Vespa orientalis Linn.

Widely distributed. Various localities in Bengal; Ranchi; Persia; Baluchistan.

Vespa basalis Smith.

Sikkim, 4,000–6,000 ft.; Assam; Dehra Dun.

Vespa bicolor Fabr.

Darjiling District; Mishmi country, Assam Frontier.

Vespa germanica var. *flaviceps* Smith.

Mussorie; Kumaon; Simla Hills; Nepal. Bingham regarded this form as a distinct species, but Du Buysson[1] rightly considers it a variety of *V. germanica*, which together with *V. rufa* was a few years ago, recorded from India by Cameron.[2]

Vespa auraria Smith.

Sikkim; Shillong, Assam; Kashmir; Nepal.

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[1] *Ann. Soc. Ent. France*, 1904, p. 64.

[2] *Zeits. Hym. Dipt.* III, p. 317, 1903.

16. On the Rationalisation of Algebraic Equations.

By Nripendra Nath Chatterjee.

In continuation of a paper read on the same subject before the Asiatic Society of Bengal on the 3rd September, 1919[1], a new method is proposed for rationalising algebraic equations.

Let the equation to be rationalised

be $$x = f\left(p^{\frac{1}{n}}\right), \quad (n \text{ an integer})$$

which can be put under the form

$$x - \left(A_0 + A_1 p^{\frac{1}{n}} + A_2 p^{\frac{2}{n}} + \ldots + A_{n-1} p^{\frac{n-1}{n}}\right) = 0,$$

$A_0, A_1, \ldots A_{n-1}$ being rational.

If we put $y = -x + A_0$, the equation becomes

$$y + A_1 p^{\frac{1}{n}} + A_2 p^{\frac{2}{n}} + \ldots + A_{n-1} p^{\frac{n-1}{n}} = 0 \qquad (1)$$

multiplying both sides by $P_1 p^{\frac{1}{n}}, P_2 p^{\frac{2}{n}}, \ldots P_{n-1} p^{\frac{n-1}{n}}$, we get

$$P_1B_0 + P_1B_1 p^{\frac{1}{n}} + P_1B_2 p^{\frac{2}{n}} + \ldots + P_1B_{n-1} p^{\frac{n-1}{n}} = 0 \qquad \ldots (2)$$

$$P_2C_0 + P_2C_1 p^{\frac{1}{n}} + P_2C_2 p^{\frac{2}{n}} + \ldots + P_2C_{n-1} p^{\frac{n-1}{n}} = 0 \qquad \ldots (3)$$

....

$$P_{n-1}V_0 + P_{n-1}V_1 p^{\frac{1}{n}} + P_{n-1}V_2 p^{\frac{2}{n}} + \ldots + P_{n-1}V_{n-1} p^{\frac{n-1}{n}} = 0 \ldots (n)$$

where $B_0, B_1, B_2, \ldots C_0, C_1, \ldots\ldots, V_0, V_1, \ldots V_{n-1}$

are rational functions of $y, p, A_1, A_2 \ldots A_{n-1}$; and $P_1, P_2, \ldots P_{n-1}$ being as yet undetermined coefficients.

Adding the above equations, we get

$$y + P_1B_0 + P_2C_0 + \ldots + P_{n-1}V_0 = 0 \qquad (A)$$

if

$$A_1 + P_1B_1 + P_2C_1 + \ldots + P_{n-1}V_1 = 0 \qquad (1')$$

$$A_2 + P_1B_2 + P_2C_2 + \ldots + P_{n-1}V_2 = 0 \qquad (2')$$

$$A_{n-1} + P_1B_{n-1} + P_2C_{n-1} + \ldots + P_{n-1}V_{n-1} = 0 \qquad (\overline{n-1}')$$

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[1] Cf. *Journ. Asiat. Soc. Beng.* (*n. s.*) XV, pp. 305–307, 1919.

which equations are sufficient for the unique determination of

$$P_1, P_2, \dots P_{n-1}.$$

Substituting these values in (A) and putting $y = -x + A_0$, we get the rationalised equation in x.

The equation in its lowest dimensions must be of the n^{th} degree as otherwise proved.

The same method is also applicable to the rationalisation of the equation

$$x = f(p^{\frac{1}{l}}, q^{\frac{1}{m}}, r^{\frac{1}{n}}, \dots)$$

where $p^{\frac{1}{l}}, q^{\frac{1}{m}}, r^{\frac{1}{n}}, \dots$ are not rational.

17. Discovery of Bengali (?) dramas in Nepal.

By Kumar Gangananda Sinha

Seven years ago four dramas were discovered in manuscript form in Nepal. These are—

1. काशीनाथ कृत विद्याविलाप
2. कृष्णदेव कृत महाभारत
3. गणेश कृत रामचरित and
4. धनपति कृत माधवानल कामकन्दला

All of these were written in Newāri script. They are of great importance in more than one way The exact nature of the popular plays in the 17th and the 18th century as revealed by these compositions is worth considering. Here, however, I confine myself to the discussion of the question of the language of some of these dramas. The Bangīya Sāhitya Parishad has published them in Bengali script and the collection is called "नेपाले बाङ्गला नाटक" (Bengali dramas in Nepal).

Of these, the first two were written under the auspices of Bhūpatīndra Malla, the last but one of the Malla Rājās of Bhātgāon. His reign of 34 years, as we know from the History of Nepal (written in Parbatiyā language by Munshi Shewsanker Singh and Pandit Sri Gunānanda and translated by D. Wright), included the years 817 Nepāl Saṁvat (1697 A.D.) to 841 Nepāl Saṁvat (1721 A.D.). The last two were written in the reign of his son, Raṇajit Malla.

A careful examination of these plays will show it beyond doubt that the language of रामचरित्र by गणेश differs from that of the other three works. For example, I give the following extracts culled at random from the above mentioned books.

In काशीनाथ कृत विद्याविलाप we have (at p. 7)—

> "गुरुक पाद पद्म सेवि शास्त्र अस्त्र शिख(ष)ह आज
> बाण जोरि रच्छ ताकि (डाकि) मारि बेध करह काज"

In महाभारत of कृष्णदेव we have (p. 43)—

> "तनय रतन देखि सुख मोर (मोल) भेल
> आयब आन बन सब दुख गेला।

In माथवानल कामकन्दला of धनपति we have (p. 219)—

“ निके (पुक) सिँगारव आँग सुरभि-तेल-कसाय
सखि आवेहे भूषण पहिराय ”

But in the रामचरित्र of गणेश we have (p. 155)—

“ रङ्गभूमि, दशरथ दिलेन प्रवेश ।
प्रवल नृपति मा(इ)ने जाहार निदेश ॥
कौशल्या केकयी आदि नारीगण संगे ।
सुमन्त्र सचिव धीर, परम सुरंगे ॥
श्री रणजित मल्ल दिलेन निदेश ।
वर्णा करिते आजि नृपरे प्रवेश ॥ ”

This fact attracted also the notice of Mr. Nanigopa, Bandopadhyaya, the editor of this collection. But he believed them to be the specimen of old Bengali, with admixtures of foreign tongues. In the preface of the book he says :—

“ इहादेर मध्ये प्रथम तीन खानी जे बाङ्गालीर लेखा, से विषये सन्देहई नाई । इहादेर भाषा कृष्णराम कबि, बनमाली दास, भारतचन्द्र ओ रामप्रसादेर भाषारई मत ; तबे एकटू येन पुरान छाँदे । दुई एकटा विदेशी कथाउ आछे ; विशेष विद्याविलाप ओ महाभारतेर मध्ये ” ।

I wonder why he leaves out of account the last book, viz. माधवानलकामकन्दला. It has greater resemblance to विद्याविलाप and महाभारत than रामचरित्र has. As a matter of fact विद्याविलाप, महाभारत and माधवानलकामकन्दला are written in one and the same language which is different from that of the रामचरित्र .

The language of रामचरित्र is distinctly Bengali and Mr. Nanigopal Banerji rightly points out some of the peculiarities that distinguish the language of रामचरित्र from that of the remaining works. In विद्याविलाप and महाभारत he finds that क is added to a word to make it a Genetive case, तह to make it an Ablative case, and हि to make it a Locative case. His attention was also drawn to the words हमे, हमराके, तोहे and तोहर . But curiously enough, all these peculiarities in case-endings and words, which appear to the learned editor as old forms of Bengali, are really forms of Maithili. These peculiarities are met with in the current speech of Maithils. They even now use the words, mentioned above, in their ordinary conversation as well as in literature.

Apart from these, it would appear quite clear to even a superficial observer that the following words which are selected at random from বিদ্যাবিলাপ, মহাভারত and মাধবানলকামকন্দলা are not Bengali but Maithili. They are used by Maithils in the very same form in which they appear in the above-mentioned books.

লগ	meaning 'near.'
পখারব	meaning 'to wash.'
ঘুঠি সোহার	—an idiom, meaning 'Excessively.' Literally, it means 'covering the ankles' and probably it had its origin from the mode of wearing clothes top to toe. Sometimes the idiom qualifies *friendship.*
খেলায়, জায়, হসি,	—These words are used as Participles.
কওন	meaning 'what.'
জনি	meaning 'as if.'
চলূ	meaning 'Let us go.'
ভজূ	meaning 'You should (or let us) worship' formed by the addition of ঊ They are used in Potential mood; second person. Words in this form signify respect.
ওতয়	meaning 'there.'
এতয়	meaning 'here.'
ধিয়া	meaning 'daughter.'
কয়লহ	meaning 'You have done'—used in Perfect tense; second person This form is used in addressing the inferiors or persons near and dear.
বচাবহ	—meaning 'Save me.'
সিখহ	—meaning 'learn this' formed by adding হ্ used in Potential mood; second person. This form is used in addressing the inferiors or persons near and dear.
নিকে	meaning 'in a nice way'—used as an Adverb.
ভেল	meaning 'took place.'
বহিনিক	meaning 'belonging to sister.'
সগরে	meaning 'everywhere,' 'whole,' 'entire.'
এহাক	meaning 'your.'
লাগল	meaning 'attached.'
অয়লাহ	meaning 'Came.'
ওহি	meaning 'that.'
করব গয়	meaning 'shall go to do.'
হোয়ত	meaning 'will occur.'

मारल meaning 'will kill' or 'will hurt' used as simple future by adding अल् .

होउन meaning 'Let it be'—Potential mood, second person.

कहैछिअ meaning 'I tell you'—Present tense; second person. This form is used when addressed to inferiors or persons near and dear.

अधिकाए —a colloquial term meaning 'to show oneself to be a great man.' In this form it is addressed to inferiors.

But there is such a close resemblance between Bengali and Maithili that one should not be surprised that the editor has fallen into such an error as this. Not to speak of the old forms of these languages, even a piece in modern Bengali can pass as Maithili, if only some changes are introduced into it. Both these languages stand to each other as uterine sisters. But the points noted above, which are points of difference leave no doubt as to the language of three of these dramas being Maithili and not Bengali.

18. Madra.

By H. C. Ray, M.A.

Madra has been generally taken roughly to correspond to modern Sialkot and its adjacent districts to the west of the Rāvi in the central Punjab. But according to some it once extended from the Beas to the Chenab and even to the Jhelum.[1] Its capital was Śākala or Sāgala-nagara, modern Sialkot. In the general history of ancient India Madra has played not an unimportant part; yet up to the present no systematic attempt has been made to write out a connected narrative of it by joining together the many scattered pieces of information. In writing this article my humble aim has been to try to present such an account.

In the Vedic literature Madra denotes a people and appears to have been divided into two sections. The southern Madras lived in the Punjab while the northern section—the Uttara Madras probably lived as Zimmer conjectures, in the land of Kashmir not far distant from the Kambojas.[2] They are mentioned in the *Aitareya Brâhmaṇa*[3] as living beyond the Himalayas (*pareṇa Himavantam*). According to some scholars the Uttara Madras had a non-monarchical constitution They refer to a passage[4] in the *Aitareya Brāhmaṇa* which mentions that among the Uttara Kurus and the Uttara Madras the whole community (*janapadāḥ*) was consecrated to rulership and their institution was called *Vairājya* M. Haug for the first time took the word *Vairājya* to mean "without king" because in the passage in question "are the *janapadāḥ*, i.e people in opposition to the king mentioned as *abhishikta*, i.e. inaugurated, whilst in all other passages of this chapter, we find instead of them the *rājānaḥ* or kings."[5]

He has of late been followed by Mr. Jayaswal[6] and Dr R. C. Majumdar.[7] But Dr. Raychaudhuri points out that *Vairājya* does not necessarily mean '*kingless*.' It is derived from *Virāṭ*, a designation applied to great kings, as well as to the consecrated rulers of the northern *Janapadas*. In the *Utkrośana* passage of the *Aitareya Brāhmaṇa*[1] the king consecrated with the *Aindramahābhisheka* is called *Virāṭ*, worthy of *Vairājya*. The rendering of *Vairājya* by *kingless* would make according to him a king worthy of a *kingless State*

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[1] Cunningham, *Ancient Geography of India*, p. 185.

[2] *Altindisches Leben*, p 102. *Vedic Index*, Vol. I, pp. 84–85 It is probable that the Uttaramadra country formed the cradle land of the Madras from which they subsequently migrated in the Punjab.

[3] VIII, 14, 3. [4] *Ibid.*

[5] M. Haug's Trans of the *Aitareya Brāhmaṇa*, p. 518n.

[6] *An Introduction to Hindu Polity*, *Modern Review*, Vol, XIII, 1913, p. 538.

[7] *Corporate Life in Ancient India*, 1st ed. p. 89.

Madra was once a centre of learning and noted for refinement in manners. We have mention in Vedic literature of two celebreties of Madra viz. (1) *Kāpya Patañchala* who is represented as a contemporary and teacher of *Uddālaka Āruṇi* the veteran Vedic scholar and philosopher of *Kuru Pañchāla*[2] and (2) *Sauṅgāyani* another teacher mentioned in the *Vaṁśa Brāhmaṇa*[3] whose pupil was *Aupamanyava* of *Kamboja*. Zimmer conjectures with probability that the epithets *Madragāra* and *Kāmboja* attached to the names of *Śauṅgāyani* and *Aupamanyava* point to a connection of the Madras and Kambojas.[4] The very word Madra as evidenced by *Pāṇini* (II.3.73; IV.4. 67) is a synonym for *Bhadra* and *Maṅgala* or that which is good, auspicious and benificent. The description of Madra princesses in the *Jātaka* and *Epic* stories fully bears out the truth of this surmise.

Pāṇini mentions a place named Sâṅkala[5] which according to some is to be identified with Śākala the capital of Madra. But Sir R. G. Bhandarkar adduces good grounds for believing that it should rather be traced to Sangala of the historians of Alexander, a city which is quite distinct from Śākala.[6]

The Maddas and their capital city Sāgala are often mentioned in the *Jātaka and the Epic* stories.[7] In a verse of the *Vidhurapaṇḍita Jātaka* the Maddas are mentioned with lofty Pañcāla Surasena, Macchas and Kekakas.[8] The Birth Stories and the *Great Epic* represent the Madras as living under a monarchical constitution and we read often of matrimonial alliances with the neighbouring royal families. In two of the *Jātakas* we hear of such alliances with the kings of Benares In the *Mūgapakkha Jātaka*[9] Caṇḍādevî the chief queen of king Kāsirājā of Benares was a daughter of a king of the Maddas So was Subhaddā the queen of another Benares king.[10] In the *Kusa Jātaka*[11] princess Pabhâvatî the eldest daughter of the

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[1] VIII, 12.

[2] *Brihadāraṇyaka Upanishad*, III 3, 1; 7, 1.

[3] *Indische Studien* 4, 372. *Vedic Index*, Vol. II p. 149.

[4] *Altindisches Leben*, 102; *Vedic Index*, Vol. II, p. 123.

[5] IV, 2. 75.

[6] *Indian Antiquary*, Vol. I, p. 22.

[7] *The Jātaka* Trans. Ed. by Cowell; IV, 479. V, 514, 531. VI, 538, 545, 547. *Mbh.* VIII, 40–45

[8] VI, 545.

[9] VI, 538.

[10] V, 514. It is to be noted that in both the cases the Benares king is said to have possessed 16,000 wives. This is interesting in view of the popular tradition about Śrîkṛshna and his 16,000 Gopîs. In Jātaka No. 531 the Malla king Okkāka is also said to have possessed 16,000 wives.

[11] V, 531. This story also appears in a variant form in *Mahāvastu*, Senart, II, 441 et seq.

Madda king is married to the ugly prince Kusa, son and heir of the Malla king Okkāka, who is said to be the "chief king in all India," while in the *Kāliṅga-Bodhi*[1] and *Vessantara Jātakas*[2] similar alliances are reported with Kaliṅga and Sivi kingdoms respectively. It is curious that in all these marriages the Maddas always supply the brides—a fact borne out by the *Great Epic* and the *Mahāvaṃsa*. In the former princess Mādrî is married to Pāṇḍu of the House of the Kurus and in the latter the queen of Sumitta king of Lāḷa (Rāḍha) is the daughter of a certain Madra king.[3] According to a Buddhist tradition one of the principal queens of Bimbisāra king of Magadha was Khemā a Madra princess.[4] The reason why the Madra princesses were in such great demand in the royal families of India was probably their exquisite beauty. The demand for ideal beauty of a Kusa could only be satisfied by a Pabhâvatî from the land of the Maddas. Pabhâvatî was said to be so fair that from her person "Stream forth rays of light as it were of the newly risen sun. When it is dark in her closet measuring four cubits there is no need of any lamp, the whole chamber is one blaze of light."[5] In the *Mahābhārata* Madra women are mentioned as *gaurî*,i.e. faircoloured[6] while in the *Mahāvastu Avadāna*[7] the daughter of a Madraka king is described as one who in beauty had no rival in the whole of *Jambudvīpa*. In the Harivaṁśa (II 50. 2) we are told that the Madra princess *Lakśhaṇā* was the sixth of the eight Paṭṭanāyikāḥ or chief queens amongst the 16,000 wives of Srī-Kṛishṇa.

Madra has no place in the 'stereotyped' list of the *Solasa mahājanapada*, i.e. Sixteen Great Countries which occurs in no less than four places of the *Aṅguttara Nikāya*,[8] or in the slightly different list of the Jaina *Bhagavatî Sutra*.[9] The early custom of employing the name of the people to denote the country which is in evidence in the list of the mahâjanapadas in the

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[1] IV, 479. [2] VI, 547.

[3] *Mbh*, I, 113; *P.T.S.* Trans by Geiger. p. 58. Lāḷa is sometimes taken to correspond to Lāta ie Gujarāt. See *The Cambridge History of India*, Vol. I, p 606. But Rāḍha seems to better agree with the geographical data contained in the *Mahāvaṁsa*

[4] *The Cambridge History of India*, Vol I, p. 183. Khemā is probably the same as Maddā who is mentioned in *The Book of Kindred sayings P.T.S.* Trans. p. 38n as the mother of Ajātasattu.

[5] *The Jātaka* Vol. V, pp. 145-46.

[6] *Mbh* VIII, 44, 16-18. Madra women are still remarkable for the regularity of their features and comparatives fairness of colour.

[7] *Le Mahāvastu*, Senart, II, 441 et seq. Here the curious statement is made that a Madraka king ruled in the city of Kanauj in the Śūrasena janapada. It is possible, however, that there was a second Kanauj in the kingdom of the Śūrasenas over which the Madras had at this period extended their sway or it might as well be that the Śūrasena territories had extended so far as to include Kanauj.

[8] I, 213. IV, 252, 256, 260. Rhys Davids, *Buddhist India*, p 23.

[9] Hoernle *Uvāsagadasao* Vol. II, App. pp. 6-7.

Anguttara Nikâya[1] is also evident in the Jātakas and the rulers are generally designated "King of the Maddas." The reason probably for the absence of Madda in the above lists is that in the period represented by the *Nikāya* and the *Bhagavatî Sūtra,* it was annexed to one of the neighbouring "Great countries" probably Gandhāra whose king Pukkusati in Buddha's time maintained diplomatic intercourse with king Bimbisāra of Magadha.[2]

In the Jātakas we do not get much about the manners and customs of the Madras. This is supplied by the Karṇaparva of the *Mahābhārata.* The Madra country in the period which saw the composition of this portion of the *Great Epic.* was looked down upon by the orthodox communities of the 'middle-country' watered by the Sarasvatî, Ganges and the Yamunâ. This is clearly revealed by the sharp passage at arms between the Madra king Śalya and Karṇa. Though some allowance must be made for the fact that the description and epithets were used in a quarrel, there can be no doubt that there is a substantial basis of truth in the remarks. Karṇa here poses as the champion of the orthodox community. Thus he says:—

"There is a town of the name of Çākala, a river of the name of Āpagā[3] and a clan of the Vāhikas known by the name of the Jarttikas. The practices of these peoples are very censurable. They drink the liquor called *Gauḍa* and eat fried barley with it. They also eat beef with garlics.... of righteous practices they have none ... Their women intoxicated with drink and divested of robes, laugh and dance outside the walls of houses in cities..... Maddened with drink, they call upon one another, many endearing epithets."[4] And again:—

"How indeed would the Madrakas and Sindhu-Sauviras know anything of duty, being born, as they are, in a sinful country, being *mlecchas* in their practices, and being totally regardless of all duties?"[5]

The above quotations fully illustrate the contempt and aversion with which the Land of the Five Rivers was held at this period. This attitude of the Middle Country is a bit peculiar and demands explanation. In the Vedic period Madra was surely not a seat for unorthodoxy for we know from the *Bṛihadāraṇyaka Upanishad* that *Kâpya Patañchala* was then living among them. In the Jātakas we find the Madra princesses much in demand in the Eastern countries while in the *Great Epic* itself a princess (*Mādri*) of the House of Madra is accepted in the Kuru family, which, whatever might be said against it, was never famous for heterodoxy. Had the Madra country been so black as Karṇa paints it, such matrimonial alliances would not have been possible. Moreover we have already seen that Madra at least in the period represented by *Pāṇini* was used as a synonym for *bhadra* and *maṅgala*; how shall we then explain Karṇa's attitude?—We know that the *Great Epic* grew gradually and it might be that by the time this portion of the *Karṇaparva* was being composed there were some foreign invasions and settlements in the Punjab by casteless barbarians such as the Greeks, Sakas or Pahlavas who often make their appearances in the *Mahābhārata*, and served to lower the position of the once hallowed '*Sapta sindhava*' in the eyes of the orthodox communities which lay further east.[1]

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[1] *Carmichael Lectures* 1918. p. 48.

[2] Rhys Davids, *Buddhist India,* p. 28.

[3] Identified by Cunningham with the Ayak Nadī, a small stream which has its rise in the Jammu hills to the north-east of Sialkot. *The Ancient Geography of India,* p 185.

[4] *Mahābhārata,* Trans. by P. C. Ray, C.I.E., VIII, XLIV, 10-18.

[5] *Ibid.,* VIII, XL, 41.

Now, have we any sure data to prove that the region round Śākala was a centre of barbarian invasions? In the *Milindapañho* we read —

'*Athi Yonakānaṁ nānāpuṭabhedanaṁ Sāgalan-nāma nagaraṁ*[2] . . . *Jambudīpe Sāgalanagare Milinda nāma rāja ahosi.*'[3] The identification of Milinda with Menander the Greek king is no longer doubted and this helps to corroborate our proposition.

But the question is how did the Greeks come to occupy Madra? The invasion of Alexander must have effected its conquest,[4] but his invasion had no very permanent results. The Indian provinces conquered by him with Madra soon passed into the hands of Chandragupta Maurya 'who transmitted them to the keeping of his son and grandson'.[5] But the edicts of Aśoka recognised the existence of Greek principalities on the northwestern fringe of his empire and we have reason to believe that soon after the Sun of the Maurya Empire had set,' these principalities gradually advanced their dominions and some of them at least occupied the Madra country.

Towards the close of the 3rd century B.C. the Bactrian throne was occupied by Euthydēmos a native of Magnesia. His son Demetrius succeeded him about the beginning of the

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[1] Of course it can be contended that the peculiarities in the traits of the people of Madra were not *entirely* due to racial reasons or foreign influences. But then they were due to the survival of the traits of the peoples who composed the early vedic community in the Punjab, while a different standard of morality and orthodoxy grew up further east, thus creating a gulf between the two sections of the Indian community.

[2] Edited by Trenckner, p. 1.

[3] *Ibid*, p. 3.

[4] Sangala of Classical writers is however not identical with Śākala; Sangala was situated to the east of the Ravi, while Śākala was to the west. *Ind. Ant.* Vol. I, p. 22-23 V. Smith, *Early History of India*, p. 75 n.

[5] The Madrakas under the Mauryas appear to have been an autonomous *rājaśabdopajībi* Saṁgha. *Kauṭilya*, p. 378.

2nd century B.C. and is said to have invaded India and penetrated far into the interior. From *Strabo* it appears that he conquered a considerable portion of Northern India, presumably including Kabul, Punjab and Sindh. He is also credited with founding a city named after his father Euthydēmos which according to *Ptolemy*[1] is the same as Sagala (Śākala). After he was driven from Bactria and other Western provinces by Eukratides, that city perhaps continued to be the stronghold of his dynasty which we shall call the Euthydemean line of Madra. The founder of this dynasty seems to have a long and illustrious career and, besides Euthydemia, is credited to have founded several other cities.[2] He has been supposed to be the original of '*The grete Emetreus the king of Inde*' of Chaucer's *Knightes Tale*[3] and to be identical with the Yavana King Dattamitra mentioned in the *Mahābhārata*.[4] There is also the greatest amount of likelihood that the Greek invader mentioned in the *Mahābhāsya* of Patañjali and in the *Mālavikāgnimitram* of Kālidāsa whom the Suṅgas claim to have encountered and routed was Demetrius as Professor Bhandarkar and Dr. Raychaudhuri suggest and not Menander.[5] Two Greek figures loom large as the invaders of India during this period viz. Demetrius and Menander.[6] We know from the synchronism of Demetrius with Eukratides who was himself a contemporary of Mithridates I (c 171-136 B.C.) that Demetrius was a contemporary of Pushyamitra Suṅga (c. 185-149 B C). Now the invasion took place surely during the early period of the reign of Pushyamitra when he was still a *senāpati* and when he had not yet performed his Aśvamedha sacrifice—possibly before 150 B.C. But there is no place before this date for Menander in the Śākala region as we shall see later on. This finds additional support from the testimony of the *Milindapañho* that the Yona king Milinda flourished in the 5th century after the Great Nirvāṇa (*parinibbānato pañcavassasate atikkante*)[7]

Apollodotos was probably the second king of this dynasty. We know that Eukratides and Apollodotos were contemporaries from the restriking of the latter's Kapiśā coins by the former.[8]

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[1] *Ind. Ant.* Vol. XIII, p. 350. The city was called Euthydemia. Nobbe's and other texts give the apparently erroneous reading Euthymedia.

[2] *J.R.A.S.* 1915, p. 830; *Ind. Ant.* Vol. XL, ***Foreign Elements in the Hindu Population***, p. 12. In my treatment of the History of the House of Euthydemos I have mainly accepted the views of Dr. H. C. Raychaudhuri.

[3] Rapson, *Ancient India*, p. 123. [4] *Mahābhārata* I, 139, 21-23.

[5] Smith, *Early History of India*, App. I, p. 213. *Ind. Ant.*, Vol. XL, p. 11 n.

[6] *Strobo*, (Falconer's version). Book XI, section xi, 1.

[7] Edited by Trenkner, p. 3.

[8] Rapson, *Ancient India*, p. 133; *J.R A.S.* 1905, p. 785.

These coins are also an evidence of the transfer of the North-western frontier of India from Apollodotos to the family of Greek princes founded in Bactria by Eukratides. Coins of Apollodotos bearing the figure of the Greek goddess, Athene. hurling the thunderbolt which is a characteristic of the Euthydemean line are found in the United Provinces and all over North-Western India. The wide distribution of his coins which suggests a rule over extensive territories finds a corroboration from the statement of the Periplus that the coins of Apollodotos were still current at the port of Barygaza (Broach).[1] On his coins Apollodotos bears the title Philopator. He must have been an early if not the immediate successor of Demetrius as the interval between the two could not have been long both being contemporaries of Eukratides[2] His coin legend seems to indicate that he was a scion of the royal house of Euthydemos though the exact relationship is not certain.

The next rulers of this dynasty appear to be Strato I and Agathokleia whose coins are of the Demetrian type. Whether the succession was immediate or not is not very sure. Their succession cannot, however, be long after that monarch for we know that Apollodotos was a contemporary of Eukratides while Agathokleia and Strato I were contemporaries of Heliocles[3] the son of Eukratides. Agathokleia is taken by Gardner to be the wife of Strato I but by others she is regarded as his mother who was regent during his minority In the later portions of his (Strato I) reign he was associated in government with his grandson Strato II.[4]

All the above kings appear to have ruled over Śākala region and so Menander has no place in the long chain formed by the four reigns from Demetrios to Strato II. Now if Demetrios flourished c 200—171 B.C. Menander possibly could not have flourished before the beginning of the 1st century B.C This finds additional support from the passage of the *Milinda-pañho* already quoted which says that king Milinda flourished in the 5th century after the Great Decease.[5]

Menander seems to have been the next king in this family. That he was a scion of the House of Euthydemos is indicated by the similarity of the coin types, his close association in literature with the Euthydemean kings[6] and lastly by the situation of his capital in Śākala. He must have been a great ruler. His coins were found in circulation by the author of the *Periplus* (c. 80. A.D) in Barygaza. Strabo in his *Geography*[1] mentions Menander as one of the two kings who were instrumental in spreading Greek dominion farthest to the east in India and as one who conquered more nations than Alexander. He crossed the Hypanis (Sutlej) and penetrated as far as the Isamos (?). Plutarch[2] tells us that he was as a ruler noted for justice and enjoyed such popularity that upon his death diverse cities contended for the possession of his ashes. This is of importance as showing the complete Indianisation of the Yavana rulers of Madra. The identification of Menander with king Milinda is now no longer in dispute and *Milindapañho* was surely based upon the tradition that lingered and kept alive the memory of the great Indo-Greek king who was also an admirer of the Law of Buddha. From the same book we know that the king was born in the island of Alasanda.[3]

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[1] Edited by Schoff, pp. 41–42.

[2] The assumption of V. Smith that Apollodotos was the son of Eukratides and a parricide seems to be a gratuitous supposition. V. Smith, *Early History of India*, 1914, p. 224. *J.R.A.S.* 1905, pp. 784–85.

[3] This is inferred from the frequent restriking of the coins of Agathocleia and Strato I by Heliocles. Rapson, *J.R.A.S.* 1905, p 165

[4] Joint coins of the two Stratos have been found. Whitehead's *Catalogue of the coins in the Panjab Museum, Lahore*, p. 81.

[5] *S.B.E.* Vol. XXXV, p. 6. [p. 42,

[6] *Strabo.* (Falconer's version) XI, xi, 1; *The Periplus.* Ed. Schoff.

Madra attained great prosperity under the Euthydemean line. There is a vivid description of the prosperity of the city of Sāgala in *Milindapañho* from which we shall quote a few lines:—

"There is a country of the Yonakas a great centre of trade, a city that is called Sāgala, situated in a delightful country.... wise architects have laid it out and its people know of no oppression.... Brave is its defence with many and various strong towers and ramparts.... well displayed are the innumerable sorts of costly merchandise with which its shops are filled..... Its streets resound with cries of welcome to the teachers of every creed.. ... Shops there are for the sale of Benares muslin.... and other clothes of various kinds..... guilds of traders in all sorts of finery display their goods in the bazars.... So full is the city of money and of gold and of silver ware, of copper and stone ware that it is a very mine of dazzling treasures.... In wealth it rivals the Uttara Kurus and in glory it is as Âlakamandā, the city of the gods."[4]

With Menander probably passed away the glory of the Euthydemean House of Madra and the Sialkot region gradually passed in the hands of the Śakas who about this time poured into the Indus valley possibly from Śakastēnē (mod. Sistān). Two Satrapal families of these Śakas ruled at Taxila and Mathurā. The seat of the imperial power probably lay somewhere south of these settlements on the Indus. The *Periplus* mentions Minnagara on the Indus as the metropolis of Scythia.[5] The identification of this city is not yet certain. The Śaka sātraps of Mathurā [1] who imitate the coins of the Stratos probably extinguished the Euthydemean line.

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[1] Ed., Falconer. XI, xi, 1.

[2] *Num chron*, 1869, p. 229.

[3] Alexandria; *S.B.E.* XXXV, p. 127.

[4] *S.B.E.* XXXV, pp. 2-3.

[5] Edited by Schoff, p. 37.

After the Scythians Madra probably passed into the control of the Parthian kings, who ruled in the 1st century A.D. After their rule Panjab was gradually annexed by Wima Kadphises the king of another horde of casteless barbarians, viz. the Yueh-chi. How long the Kushaṇas controlled Madra we are not sure; but their rule over Madra must have ended early in the 4th century A.D. From Ptolemy [2] who wrote in c. 150 A.D. it appears that the immediate possession of the Śākala region was held by the Pandoouoi identified by McCrindle with the Pāṇḍavas.

After the Great Kushaṇas the Madras must have asserted their independence. For next we hear of them in the Allahabad Pillar Inscription of Samudra Gupta (c. 330-375 A D.) as an autonomous frontier tribe "giving all (*kinds of*) taxes and obeying (*his*) orders and coming to perform obeisance."[3] The "Mādrakas" probably formed at this period a tribal republic and as such are differentiated in the inscription from the list of frontier kings and countries and associated with the Mālavas, Ârjunāyanas, Yaudhêyas Abhîras, Prârjunas, Sanakânîkas, Kākas, Kharparikas and other tribes

Madra remained under the Gupta power till the Epthalite invasions when the outlying frontier provinces fell off. The Śākala region became one of the strongholds of the Hūṇa power. Hiuen Tsang informs us that 'some centuries ago' a king called Mo-hi-lo-kiu-lo (Mahira or Mihira kula) established his authority in the town of She-kie-lo (Śākala) and ruled over India. He was quick of intellect and naturally brave and subdued all the neighbouring provinces without exception [4] The founder of the Huṇa kingdom of Madra was probably Toramāṇa the father of Mihirakula and a leader of the Huṇa invaders. His date is established by his synchronism with Dhanyavishṇu the brother of Mātrivishṇu. His rule extended to Arikiṇa Vishaya in Malwa after Budha Gupta (485–86 A.D).[5] When Toramāna died his dominions which extended from Śâkala to Malwa passed to his son Mihirakula. From the testimony of Hiuen Tsang it is apparent that Mihirakula was a very powerful prince. He must have ruled at least fifteen years and his dominion included the Gwalior region.[6] East of this however he could not proceed. The Parivrâjaka Mahārājas the feudatories of the Guptas seemed to have successfully withstood the onslaught of the Hūṇa from Central India.

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[1] The family of Rañjubula.

[2] *Geography of Ptolemy. Ind. Ant.* Vol. XIII, pp. 349-340.

[3] Fleet, *Corpus Inscriptionum Indicarum*, p. 14.

[4] Beal, *Buddhist Records* Vol. I, pp. 167–168.

[5] Fleet, *Corpus Inscriptionum Indicarum*, pp. 90 and160.

[6] *Ibid.*, p. 162.

The glory of the Hūṇa dynasty of Madra was however short lived. Hiuen Tsang informs us that one Bālādityarāja king of Magadha defeated and captured Mihirakula.[1] The credit of defeating Mihirakula is also claimed by Yaśodharman (532-33 A.D) in his Mandasor Pillar inscription.[2] There is a good deal of controversy about the agent who really defeated the Hūṇa king. V. A. Smith identifies the Bālāditya of Hiuen Tsang with Narasiṁha Gupta Bālāditya the grandson of Kumāra Gupta I and the son of Pura Gupta.[3] But Hiuen Tsang himself says that this Bālāditya was the grandson of Budha Gupta (Fo-to-kio-to) and son of one Tathāgata Gupta (Ta-tha-kie-to-kio-to) and so the Bālāditya whom the pilgrim meant cannot be Narasiṁha Gupta[4] This Bālāditya must apparently be identified with a Gupta sovereign who flourished after Budha and may be identical with the nameless Gupta king of the recently discovered Damodarpur plate dated in the Gupta year 214 (A.D 533–34). Our assumption finds some corroboration from the fact that this inscription is dated nearly in the same years as that of the Mandasor inscription of Yasodharman (533 A.D.) and it is probable that the Huṇa chief fell to a double attack from both his flanks.[5]

If we are to believe Hiuen Tsang, Mihirakula fled to Kashmir after his defeat where he repaid the hospitality of the king by treacherously murdering him and usurping his throne.[6] The throne of Madra, during the absence of Mihirakula in the wars with Bâlâditya, was seized by his brother. The Hûṇa power probably continued in the Sialkot region for a long time even after this serious reverse In the *Harshacharita*, Prabhākaravardhana is called by Bāṇa 'a lion to the Hûṇa deer.'[7] Where could the Hûṇa power possibly lie during this period? It could not be in Malwa where lay the remnants of the Gupta power; it had also no place in Rajputana where the rising power of the Gurjaras of Bhilmāl held its sway. But it was probably in the Sialkot region just to the north-west of the Pushyabhūtis of Sthâneśvara that the Hûṇa stronghold was situated and it is quite natural that they should come in hostile conflict with each other. It was probably this Hûṇa state which Hiuen Tsang calls Tseh-kia or Chêh-ka the capital of which was an unnamed city about 20 li in circuit, and situated about 14 or 15 li to the north-east of the old capital Śākala. Śākala was then in a decayed condition, its walls being thrown down. The pilgrim, however, saw a little town about 6 or 7 li in circuit within the old walls of the city, the people of which were rich and prosperous. The capital was probably removed from Śākala after the defeat of Mihirakula. Hiuen Tsang provides us with an account of the Hūṇa kingdom. He informs us that the

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[1] Watters' *Yuan Chuang*, pp. 286–291.

[2] Fleet, *Corpus Inscriptionum Indicarum*, pp 146-47.

[3] V. Smith, *Early History of India*, p. 318.

[4] Raychowdhury, *The Gupta Empire in the sixth and seventh centuries A.D.*, *J.A S.B* 1920, p. 315.

[5] *Ibid.*, p. 317 Prof Raychowdhury identifies Bālāditya with "the glorious Bhānu Gupta mentioned in the Eran Stone Pillar Inscription of Goparāja dated in the year 191 (511-12 A.D.)." Fleet, *Corpus Inscriptionum Indicarum*, p. 93.

[6] Watters' *Yuan Chwanq*, pp. 288-289.

[7] Cowell, *Harshacharita*, p 101

> "soil is suitable for rice and produces much late sown corn. It also produces gold, silver and stone called *teou*, copper and iron. The climate is very warm and the land is subject to hurricanes The people are quick and violent, their language coarse and uncultivated For clothing they wear a very shining white fabric which they call *kiau-che-ye* (*kauśeya* silk), and also morning red cloth (*chau hia*) and other kinds Few of them believe in Buddha; many sacrifice to the heavenly spirits (*Devas and Spirits*) There are 10 *Saṅghārāmas* and some hundreds of temples. There were formerly in this country many houses of charity *goodness* or *happiness* (*Puṇyuśālās*) for keeping the poor and the unfortunate. They provided for them medicine and food, clothing and necessaries, so that travellers were never badly off."[1]

During the last quarter of the 6th century the Madras seem to have come in contact with the rising Chalukya power of Badāmi. The Mahākūṭa Pillar Inscription of Maṅgaleśa ascribes to Kîrtivarman I wide conquests including Aṅga, Vaṅga, Kaliṅga, Magadha, Madraka, Kerala etc.,[2] In the first half of the 8th century Madra probably often felt the weight of arms of the Kashmirian kings of the Karkoṭa dynasty specially of Muktāpîḍa and Jayāpîḍa. In the inscriptions of the Pālas of Bengal Madra appears in connection with the installation of Chakrāyudha on the throne of Kanauj with the assent of the neighbouring powers enumerated as the Bhoja, Matsya, Madra, Kuru, Yadu, Yavana, Avanti, Gandhāra and Kîra kings.[3] It is possible that Dharmapāla in his bid for the overlordship of Northern India came in contact with these kings and by defeating them succeeded in forcing his nominee on them.[4] After Dhārmapāla the Pratîhāra power saw its palmy days and under Bhoja (Mihira; 840-90 A D) extended its power even to the gates of Kashmir. We read in *Kalhana's Rājataraṅgiṇī* that king Śaṅkaravarman (c 855–83 A.D.) caused the sovereign power which the *adhirāja Bhoja* had seized, to be given up to the scion of the Thakkiya family who had become his servant in the office of Chamberlain. The verse runs as follows[1] :—

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[1] Beal, *Buddhist Records*, Vol. I, pp. 165–166. Also Watters' *Yuan Chwan*, p. Vol. 1, 286.

[2] *Ind. Ant*, 1890 p. 17.

[3] *Gauḍalekhamālā*, edited by A. K. Maitreya, p. 14.

[4] R. D. Bannerjee, *The Pālas of Bengal*, M.A.S.B. Vol. V, p. 51 It is curious that Mr Bannerjee is of opinion that Madra 'meant some part of Afghanistan.'

Hṛitam Bhojâdhirâjena sa Sâmrâjyam adâpayat.
Pratîhāratayā bhṛityîbhūte Thakkiyakānvaye.

There is some controversy about the identification of this *adhirāja Bhoja.* But as at this period we find no other king of the name Bhoja who is powerful enough to be called *adhirāja* it is better to identify him with the great Pratîhâra emperor. It seems therefore that Madra at this period was under the suzerainty of the Pratîhâras though it often became the bone of contention between Kanauj and Kashmir.[2]

About the history of Madra after this period little is known Just on the eve of the Mahomedan conquest we find the Sialkot region under a family of kings two of which Jayapāla and his son Ânandapâla were worsted in war by Sabuktigîn (986-997 A D.). Jayapāla ruled over most of the Punjab to the north of Sindh. Madra with the rest of Punjab seems to have been annexed to the Ghaznî Sultanate by Sultan Mahmūd (997–1030 A.D.) son of Sabuktigîn.

The history of Madra attempted in this paper is no more than a mere account of an ancient tribe conquering and conquered who having descended into the Panjab from their mountain fastnesses on and beyond the Himalayas gradually established their settlements and principalities in different parts of Northern India[3] and played no unimportant part in the political and social history of the Hindus. The Madras like some other tribes and peoples had suffered many vicissitudes of fortune and had changed their character by coming in contact with other peoples and tribes and it is inconceivable that a people whose history can be traced so late as the 11th century A.D. should leave no vestiges of their own in modern India They might have been a bubble in the sea of the vast population of India and yet this account may serve to showe that this bubble was but a recognisable sign of one of the mighty undercurrents of race and culture which have gone to build up India what it is to day.

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[1] *Rājataranginî*, V, 151.

[2] Dr. Smith, however, is of opinion that 'the rule of Parihārs never extended across the Sutlej, and the history of the Panjab between the 7th and 10th centuries is extremely obscure.' The empire of Bhoja was limited on the north-west by the Sutlej. *The Oxford History of India*, 19.0, pp 189 and 183.

[3] *Kāśikā* while commenting on *Pāṇini* IV. 2. 108. mentions *Paurvamadra* and *Āparamadra*. This seems to indicate that there were other settlement of the Madra tribe besides the two in Kashmir and the Sialkot region. But *Kāsikā* is very late and it is difficult to locate the two settlements. *Kāśikā Benares ed.* p. 325. Otto Böhtlingk, *Pāṇinis' Grammatik*, p. 182.

19. The Mahābhārata and the Besnagar Inscription of Heliodoros.

By Hemchandra Raychaudhuri, M.A., Ph.D.

The Besnagar inscription records the erection of a *Garuda-dhvaja* of Vāsudeva, the god of gods, by the *Bhāgavata* Heliodora (Heliodoros), the son of Diya (Dion), the *Takhkhasilāka* (native of Taxila), a *Yona* (Greek) ambassador, who came from Mahārāja Aṁtalikita (Antialkidas) to Rājan Kāsiputa Bhāgabhadra the Saviour (*trātāra*), who was prospering in the fourteenth year of his reign.

As this inscription is one of the earliest records of the *Bhāgavatas*, i.e. the followers of Vāsudeva-Krishṇa, it is interesting to inquire in what relation it stands to the Great Epic which calls itself ṭhe Kārṣhṇa Veda (Mbh. I, 1. 268; XVIII, 5,41).

At the outset, I beg to draw the attention of scholars to the remarkable passage which forms the second part of the famous epigraph. It runs as follows :—

Trini amuta padāni(su) anuṭhitāni
Nayaṁti svaga dama chāga apramāda

"Three immortal precepts when practised lead to heaven —Restraint, Renunciation, and Rectitude."

So far as I know no serious attempt has yet been made to find out the source from which these precepts are taken. In my *Early History of the Vaishṇava Sect* I pointed out that *dama*, *tyāga*, and *Apaiśunam* are inculcated in the *Gitā* xvi, 1-2. But *Apaiśunam* can hardly be regarded as equivalent to *apramāda*. There are, however a few verses in the *Strî parva* (7.23-25) of the *Mahābhārata* which show a closer resemblance to the passage of the Besnagar inscription. The verses are quoted below :—

दमस्त्यागोऽप्रमादश्च ते त्रयो ब्रह्मणोहयाः
शीलरश्मि समायुक्तः स्थितोयो मानसे रथे
त्यक्त्वा मृत्युभयं राजन् ब्रह्मलोकं स गच्छति ।

"Restraint, Renunciation and Rectitude—these are the three horses of Brahman. He, who rides on the car of his soul, to which are yoked these horses with the help of reins furnished by good conduct, goes, O King, to the regions of Brahma, shaking off all fear of death."

No one can help being struck by the remarkable coincidence between the Epic verses and the Epigraphic passage mentioned above. *Dama*, *Tyāga* and *apramāda* are mentioned in identical terms in both. "*Amutapadāni*" of the Besnagar inscription has its parallel in the expression त्यक्तामृत्युभयं of the Mahābbārata, while *Svaga* of the epigraph corresponds to Brahmaloka of the Epic. It is clear that there was some close connection between the teaching of the Mahābhārata and that of the Besnagar Inscription

There is another important fact which should not be overlooked. Heliodoros, the Greek ambassador to whom we owe the inscription, was a native of Takshaśilâ in Gandhāra. The city of Takshaśilâ figures prominently in the story of the recitation of the Mahābhārata. It was at this city that Janamejaya heard from Vaiśampāyana the famous story of the Kurus and the Pāṇḍus. This is clear from the following verses of the Svargārohaṇaparva.

वैशम्पायन उवाच :—
एतत्ते सर्व्वमाख्यातं विस्तरेण महाद्युते ।
कुरूणां चरितं कृत्स्नं पाण्डवानाञ्च भारत ॥
सौतिरुवाच :—
एतच्छ्रुत्वा द्विजश्रेष्ठाः स राजा जनमेजयः ।
विस्मितोऽभवदत्यर्थं यज्ञकर्म्मान्तरेष्वथ ॥
ततः समापयामासुः कर्म्मतत्तस्य याजकाः ।
आस्तीकश्चाभवत् प्रीतः परिमोच्यभुजङ्गमान् ॥
ततो द्विजातीन् सर्व्वांस्तान् दक्षिणाभिरतोषयत् ।
पूजिताश्चापि ते राज्ञा ततो जग्मुर्यथागतम् ॥
विसर्ज्जयित्वा विप्रांस्तान् राजापि जनमेजयः ।
ततस्तक्षशिलायाः स पुन रायाद् गजाह्वयम् ॥

(Mbh. XVIII, 5. 30–34.)

Vaiśampāyana said :—

I have now told you, O you of great splendour, every thing about the acts, O Bhārata, of both the Kurus and the Pāṇḍavas

Sauti said :—

Hearing this, O foremost of twice-born ones, at the intervals of sacrificial rites, King Janamejaya became filled with wonder.

The sacrificial priests then finished the rites which remained to go through. Āstika, having rescued the snakes (from a fiery death) became filled with joy.

King Janamejaya then pleased all the Brāhmaṇas with profuse presents. Thus adored by the king, they returned to their respective abodes

Having dismissed those learned Brāhmaṇas, King Janamejaya *returned from Takshaśilā to Hāstinapura.*

(M. N. Dutt Śāstrî's translation.)

The last statement shows that the king was at Takshaśilâ when Vaiśampāyana was reciting the story of the Kurus and the Pāṇḍus. It is thus apparent from internal evidence that Takshaśilâ had something to do with the diffusion of the knowledge of Vaiśampāyana's version of the Great Epic. It is significant that one of the earliest references to the Mahābhārata is found in the *Ashṭādhyāyî* of Pāṇini, a native of Sālātura which lay not far from Takshaśilâ and formed part of the kingdom of Gandhāra.

The testimony of Pāṇini shows that the *Mahābhārata* was well known to the people of Gandhāra from a period long anterior to the time of Heliodoros (second century B.C), while the evidence of the *Svargārohaṇaparva* suggests that it used to be recited by *Vāchakas* or *Pāṭhakas* in the presence of the great men of Taxila. In view of this fact, and of the remarkable coincidence between the verses of the *Strîparva* of the *Mahābhārata* and the second part of the Besnagar inscription, it is not unreasonable to think that Heliodoros of Taxila actually heard and utilized the teaching of the Great Epic. Evidently the *Mahābhārata* played an important part in the Hinduisation of the foreign settlers of the Indian border-land.

20. Diḥyah al-Kalbī.

By A. H. Harley.

He is usually referred to as such, or as Diḥyah b. Khalīfah al Kalbī. His lineage is given by Ibn Sa‘d (*Ṭabaqāt*, IV, I, 184) as :—

دِحْيَة بن خَلِيفة بن فَرْوَة بن فُضالة بن زيد بن امرئ القيس بن الخزرج [1]
و هو زيد مناة بن عامر بن بكر بن عامر الأكبر بن عوف بن بكر بن عوف بن عُذْرة
بن زيد اللّات بن رُفيدة بن ثور بن كلب بن وَبرة بن تغلب بن حُلْوان بن عمران
بن الحاف بن قُضاعة *

Ṭabarī (*Ta'rīkh*, III, 2349) omits بن عمران but agrees otherwise : see also de Perceval's *Essai sur l' hist. d. Arabes*, Tabl. III, and '*Umdatu'l-Qārī*,' p. 93.

His name is usually pronounced Diḥyah, accepted as the better form, but the word *daḥyah* is also well known (Nawawī, *Tahdhību'l-'Asmā'*, 239), and his name is occasionally so written, e g. Ṭab., I, 1741, and alternatively in Ibn Hishām, 685, 758, Ṭab , I, 2093

He was of the Kalb tribe which early moved north out of Yemen and settled in the north of the peninsula close to the Syrian frontier (Perceval, I, 214; Nicholson's Lit. Hist. of the Arabs, 199, n. 2; also Caetani, Carte, II, 1, 464, of the *Annali*) The place and year of his birth are not stated, but it is probable that he was born in the settlement of his tribe near the border of Syria, for though Sam‘ānī says he settled in Egypt, and though his tomb is said to be at Al-Qarāfah there, it will probably be concluded from the facts of his life-history and from the consideration of the fourfold tradition, Syrian, Egyptian, Palestinian and Persian, as to his last resting-place, that as the northern half of Arabia and later Syria were the spheres of his activities his connection with them was lifelong.

He was a prominent Companion of the Prophet, but probably his junior in years, for it is asserted that he long survived him, and died in the reign of Mu‘āwiyah (r. 41–60 A.H.).

The events of the early period of his life are unknown; for chroniclers his history begins with his declaration of adherence to the new faith, or more exactly from a time slightly subsequent. There is general agreement that he was an early convert (Ibn. S., IV, 1, 184, Ṭab., III, 2349; cf Ibn Ḥajar, I, No. 2378), and that he was not present at the Battle of Badr (2 A.H.); it has been said that his first engagement was Khandaq (5 A.H.; Ibn Ḥajar, *'Iṣābah*, I, No. 2378), but usually it is stated that he was present in battlefields subsequent to Badr,—" all of them " adds Nawawī (*Tah.*, 239)

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[1] Occasionally appears as al-Khazraj, e g. Ibn Sa‘d, VIII, 114; *cf.* Ṭab., III, 2340, n. *f*.

It is said by Al-Bayḍāwī that vv. 9-11 of Sūrah LXII were revealed on an occasion when Diḥyah al-Kalbī entered Madīnah on a Friday, before his conversion, for " while Muhammad was preaching, a caravan of merchants happened to arrive with their drums beating, according to custom; which the congregation hearing, they all ran out of the mosque to see them, except twelve only. " If Diḥyah was thus reprehended. the passage may well be set down to the year 2 A.H. (Wherry's Comment on the Qurān, IV, 144–6; cf. Rodwell's Transl., Everyman's Libr. Ed., p 374).

He was evidently engaged in trade between Syria and the cities of the Ḥijāz, for he returned with merchandise on the former occasion when the Prophet sent him to the Emperor Heraclius (Ibn H., 976), who gave him passage through his territory (*Ta'r. al-Khamīs*, II, 10), or bestowed on him goods Ṭab., I, 1555) and well attired him. On his way back he fell into the hands of marauding clansmen, an occurrence which took place shortly after the conversion of Rifā'ah b. Zayd al-Judhāmī, i.e by the Second Jumādā, 6 A.H. (Caet., I. 697) The acquaintance with the Prophet may have sprung up in the course of caravan trade with the north; at any rate it may well be set down to a date prior to the engagement at 'Uḥud (3 A.H.).

" Mahomet, the Koran tells us, was inspired by the Holy Ghost, whom he held to be an angel, and whom he called, in later chapters, written at Medina. by the name of the Archangel Gabriel, which he pronounced Jabrīl. During the fits of ecstasy in which the inspiration came to him, he believed he beheld the archangel's face, and when he was asked what he was like, he always mentioned a young man of the tribe of Kalb, named Diḥyah ibn Khalīfa " (Huart, *Arabic Lit.*, 34–5).

Nawawī declares he was one of the handsomest of men (240). He owed it to this exterior quality rather than to beauty of character,—though there is nothing in his record that is not fair, the unique distinction of being likened unto Gabriel. Tradition has it that the Prophet attributed to two men an enviable similitude, and to a third a reprehensible; of the former he likened Diḥyah to Gabriel, and 'Urwah b. Mas'ūd ath-Thaqafī to Jesus, son of Mary, but the unfortunate 'Abdu'l-'Uzzā had the semblance of Dajjāl (Ibn S., IV, 1, 184), " the enemy of God " (Naw., 238). Probably the Prophet's relations with Diḥyah led to a yet more intimate union. He espoused Khaulah bint Al-Hudhail, grand-daughter of Khalīfah and daughter of a sister of Diḥyah's (Ṭab., I, 1776), or would have completed the contract but that she died on the way, ere she reached him (Ibn S., VIII, 115); in the *Ta'rīkh-i Guzīda* the marriage is not only represented as having taken place, but she is said to have been divorced (p. 157). On her death he married Sharāf, daughter of Khalīfah and sister of Diḥyah (Ibn S., VIII, 115); in the *Ta'rīkh-i Guzīda* her name is given as 'Isāf (cf Ṭab., I, 1776, n. *a*), and it is recorded that she died in Muḥammad's lifetime (pp 160–161). Another sister is noticed by Ibn S. (*ib.*); the foster mother of the afore mentioned Khaulah was her maternal aunt, Khirniq, daughter of Khalīfah.

Of descendants in the male line two are mentioned at some length. Of these one is Abū'l-Khaṭṭāb 'Umar b. al-Ḥasan b. Diḥyah al-Kalbī, who was born at Valencia, in Spain, about 544 A.H., and "was surnamed Dhū'n-Nasabain (With two Genealogics), because he was descended on his father's side, from Diḥya al-Kalbī, ... and. on his mother's, from Ḥusain, the son of 'Alī. He travelled all over Spain in pursuit of his studies, was twice appointed qāḍī of Denia, and dismissed on account of his scandalous behaviour. He took up his traveller's staff again, wandered to Morocco. and to Bijāya, where he taught the knowledge of the traditions (1198 A D). He sojourned some time in Egypt before starting on pilgrimage to Mecca and, on his return from the Holy City, made a long detour, lasting over several years, by Syria, Chaldea, and Persia. On his return, Al-Malik al-'Azīz chose him to be tutor to his son Al-Malik al-Kāmil and when that prince succeeded to power he built his old master the Madrasah Kāmiliyya, where he taught the traditions. He eventually fell into disgrace, was dismissed, and died on 30th October 1235." (Huart, *Ar. Lit*, 173) The names of five of his works are given in Brock, I, 311 In 126 A.H. the Khalīfah Yazīd b. al-Walīd desired to appoint a descendant of this family, 'Abdu'l-'Azīz b. Hārūn b. 'Abdi'l-lāh b. Di (*or* a) ḥyah b. Khalīfah al-Kalbī to the governorship of 'Irāq, but he was disposed to make a condition as to his appointment and said: "Were there to be an army with me I would accept," whereupon Yazīd let him go in favour of another (Ṭab., II, 1836), for such a stipulation was not likely to commend itself to a ruler styled Al-Nāqiṣ (the Retrencher) because of his policy of retrenching the allowances of the troops (Suyūṭi, *Ta'rīkhu'l Khulafā'*, section on Yazīd b. al-Walīd).

According to a tradition ascribed to Ibn Shihāb az Zuhrī Gabriel came to the Prophet one day at noon in the year 5 A.H., wearing a turban of embroidered silk, and riding on a she-mule with a saddle over which was velvet brocade. Gabriel expostulated with him on having laid aside his arms, and declared it the bidding of God that he should proceed against the Jewish Banū Quṛayẓah, and added that he himself was making his way thither. 'Alī was given the standard of the Muslims and was dispatched against them. The Prophet followed later, and as he passed by his companions (Najjārites, *Caet*, I, 627) in Aṣ-Ṣaurayn before reaching the Banu Qurayẓah he asked whether anyone had gone by that way. They answered that Diḥyah b. Khalīfah al-Kalbī had gone past on a white she-mule, with a saddle on which was velvet brocade. The Prophet said: "That was Gabriel, who has been sent to the Banū Quraiẓah to shake the fortresses in their midst, and cast terror into their hearts" (Ṭab., I, 1485–6). In a tradition of 'Ā'ishah it is the Banū Ghanam whom the Prophet passed on his way; here it is incidentally stated that the features and beard of Diḥyah used to be likened to those of Gabriel (Ṭab., I, 1487)

The following tradition of 'Ā'ishah is another instance in which Gabriel was mistaken by the beholder for Diḥyah. She relates: The Prophet started up violently; I looked and, lo, there was a man standing with him, on a riding-beast, and wearing a white turban, the end of which he had let hang down loose between his shoulders, and the Apostle of God (صلعم) had his hand on the mane of his riding-back I said: "O Apostle of God, your starting up made me afraid of him!" He asked: "Did you see him?" I replied: "Yes" He asked: "Whom did you see?" I answered: "I saw Diḥyah al-Kalbī" He said: "That was Gabriel,—Peace be on him," (Ibn S., IV, I, 184).

Another form of the tradition makes it a case of deliberate impersonation of Diḥyah by Gabriel: Gabriel used to come to the Prophet in the form of Diḥyah al-Kalbī (Ibn S., *ib.*, 15–18).

There is another variety of tradition in which the onlooker likens the apparition, subsequently known to be Gabriel, to Diḥyah. Ā'ishah says: I saw Gabriel standing in this room of mine, on a horse, and the Apostle of God whispering to him. Then when he entered I asked: "O Apostle of God, who was this whom I saw you whispering to?" He asked: "Did you see him?" I answered: "Yes." He asked: "Whom did you take him to be like?" I replied: "Diḥyah al-Kalbī." He said: "You saw well indeed. That was Gabriel." And she says: It was but a little afterwards that he said: "A'ishah, here is Gabriel greeting you with "Peace!" I responded: "Peace be on him too! God will reward him as a guest!" (Ibn S., VIII, 46).

The tradition takes yet one more form. The Prophet said: The likest I have seen to Gabriel was Diḥyah al-Kalbī (Ibn S, IV, 1, 184, l. 15).

He appears to have been yet more distinguished as a diplomat than as a soldier, for the Prophet entrusted to him two commissions, both to the Emperor Heraclius. In the former instance it is not clear why he was sent, but it is likely that he had been charged to obtain a concession of, or the recognition of, trading-rights in or with the Byzantine provinces (*cf.* de Perceval, III, 157). The Emperor received him favourably, and as has been previously stated Diḥyah returned with presents and merchandise. But misfortune befell him in the way of his return to Madīnah, for when he had reached as far as Ḥismā, a rugged region occupied by the Banū Judhām in the Desert of Syria, and distant from Wādī al-Qurā a two nights' journey, and from Madīnah eight nights' (*Mu'jamu'l-Buldān*, II, 267), some persons of the Judhām plundered his all. He betook himself to the Prophet in Madīnah, and lodged his complaint before he had yet crossed his own threshold, and secured the dispatch of Zayd b. Ḥārithah to Ḥismā in the Second Jumādā of the 6th Hijri year (Ṭab., I, 1555).

The above narration is supplemented by one purporting to proceed from certain well-informed persons of Judhām (Ṭab., I, 1740, 19 *ff.*), according to whom however the scene of the disaster that befell Diḥyah was the Valley of Shanār or Shinār, in Yāqūt given as Shinān. Here he was looted of all his possessions by Al-Hunayd and his son 'Uṣ ('Āriḍ in Caetani's Annali, 697; see Ṭab., I, 1741, n. *f*), of the Ḍulay', a branch of the tribe Judhām. News of the unfortunate assault reached a small party of the Banū Ḍubayb, another branch of Judhām whose chieftain Rifā'ah b. Zayd al-Judhāmī had recently had a personal interview with the Prophet, and on his return had won his tribal subdivision of Ḍubayb among others to Islām; in this matter Diḥyah had played a part, though a minor one, inasmuch as he is said to have befriended one of the clansmen of Ḍubayb, Ḥassān b. Mallah (Ḥayyān b. Millah, in Caet., 697; *cf.* Ibn H., 976, l. 10), and taught him the Sūratu'l-Fātiḥah (Ibn H., 976; Ṭab., I, 1741). This party hastened to meet Al-Hunayd and his son, and fought them and those with them for the restoration of the looted property. In this they were successful, and made it over to Diḥyah. He however was still dissatisfied, and went off in high dudgeon to Madīnah, where he sought out the Prophet and demanded the lives of the two leading miscreants. His suit prospered, for Zayd b. Ḥārithah was told off with a force against them, and in the ensuing encounter Al-Hunayd and his son lost their lives (Ibn H., 976; Ṭab., I, 1742).

His second commission was to the same quarter as the first, but its object was of an entirely different nature. In Dhu'l-Ḥijjah of this 6th year of the Hijrah six envoys were sent to the rulers of neighbouring lands inviting them to acceptance of the new faith. Three of the six were of the number of them that "companied with" Muḥammad, and Diḥyah was one of these three intimates (Ṭab., I, 1559). He was entrusted according to this account with the mission to the Byzantine ruler, Heraclius; the missive he was charged to deliver was sealed, it is said, like those to the other potentates with the silver signet-ring of the Prophet which Gabriel had approved after rejecting previous patterns in iron and copper (Tab., I, 2857). The narrative of the circumstances of its delivery as detailed in Tab., I, 1561 *ff*, with but slight differences in *Al Aghānī* (VI, 94), is all interest, if not veracity: Abū Sufyān b. Ḥarb is related to have said: "We were a community of traders. and the feud between the Prophet and us had so straitened us that our possessions were exhausted. When the Truce (of Al-Ḥudaybiyyah)[1] was concluded between the Apostle of God and us, we were not without fear that we would not find security, but I proceeded with some traders of the Quraysh towards Syria, our trade-objective there being Gaza (Ghazzah) We came to it at the time when Heraclius had proved victorious over the Persians within his territory, and had driven them out of it, and there had been wrested from them for him his Holy Cross, which they had plundered When he heard this news (of their expulsion) and that his Cross had been rescued for him, he set forth walking on foot in gratitude to God on the occasion of this restoration he had made, from Ḥimṣ where he then had his quarters, in order to pray in the Holy City (Jerusalem), carpets being spread for him (in his path), and sweet-smelling flowers cast on them. When he reached 'Iliya'[2] he offered there his prayers, his generals and the Byzantium nobles accompanying him. He appeared next morning careworn, and kept turning his glance heavenwards His generals said to him: "Your Majesty is verily careworn this morning" He answered. "Yes; I was shown yestreen the dominion of the circumcised triumphant[3]" They replied: "We are not aware of any nation that practises circumcision save the Jews, and they are under your authority and in thrall to you; wherefore send unto all over whomsoever you have authority in your realm instructions to cut off the heads of all Jews under their control, and so have peace of mind from this anxiety." They were, I swear, engaged in working him round to this view of theirs when there arrived a messenger from the Lord of Buṣrā,[1]—for the rulers used to mutually apprise each other of any news, leading in an Arab, and the message he delivered was: "O King, this man of the sheep- and camel-rearing Arabs tells of a curious matter, that hath occurred in his country; interrogate him regarding it." When the messenger of the Lord of Buṣrā brought him to Heraclius, the latter said to his interpreter. "Ask him what this affair is that has happened in his country." So he asked him, and the man replied: 'There appeared in our midst a man calling himself a prophet, and some followed and believed in him, while others opposed him, and in many places there have been fights between them. Such was the state of affairs when I left them." When he had imparted to him this information, Heraclius gave the order: "Strip him," and when they stripped him he was found to be circumcised, whereupon Heraclius exclaimed: "This, I swear it, is what I was shown; it is not as ye do say. Give him his clothes Take yourself off" (addressed to the man; see *'Aghānī*, VI, 94). Then he summoned his Chief of the Guard and commanded him: "Search Syria through and through till you bring me a man of the same people as this," i.e. the Prophet. Now I swear I was in Gaza when his Chief of the Guard burst in on us asking: "Do you belong to the same people as this person in the Hijāz?" We replied: "Yes." Then he said "Go with us to the king" We went with him, and when we reached him he asked: "Are you of the same tribe as this man?" We said: "Yes." He next asked: "Which of you is closest related to him?" I answered: "I." Abū Sufyān here interposes: "My oath on it, I never saw anyone I consider more astute than that uncircumcised one (intending Heraclius)." Heraclius next said: "Approach." Then seating me before him and my companions behind me, he said: "I will question him, and if he lies refute him." Now I could swear to it that had I lied, they would not have refuted me, but I was a chieftain in rank, too noble to stoop to mendacity; and I was aware that the least consequence involved in lying to him would be that they would remember it against me, and cite it of me,—so why should I speak falsely to him?—(*or*, so I did not

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[1] A treaty between Muḥammad and the people of Makkah, concluded in Dhu'l Qa'dah, 6 A.H. (Caet., I, 706 *ff.*).

[2] 'Iliya', actually Aelia, was the name by which the Romans had chosen to designate Jerusalem in the following circumstances: "About sixty years after the fall (70 A.H.) a man who believed himself to be the Messiah, and persuaded others of the same, Bar Cochba, heading a new nationalist movement on the part of the Jews, seized the ruined city, refortified it, and proceeded to rebuild the Temple. The revolt was not more successful than that described by Josephus; and, after its suppression, Jerusalem was turned into a Roman colony, called Aelia Capitolina, with a temple to Jupiter Capitolinus on the Temple area. ... The name Aelia supplanted the time honoured name, which for awhile belonged exclusively to the heavenly city of devotional fancy, which the fall of Jerusalem under Titus had caused to be painted in more gorgeous colours than before. Even now Aelia is with Moslems the alternative appellation for "the Holy City", and figures on the imprints of books printed at Jerusalem" (Margoliouth's Cairo, Jerusalem and Damascus, p. 190).

[3] Caetani considers it very probable that this part of the story could have been suggested by the fearful slaughter of the Jews which seems to

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have been decreed by Heraclius after the restoration of the empire, to punish them for the aid they had given, or were alleged to have given, the Persians (I, 733 n. 1); this massacre is said to have taken place in the end of 8, or the beginning of 9 A.H.

[1] A place approximately mid-way between Damascus and Jerusalem

speak falsely to him). Heraclius said: ' Tell me of this man who appeared among you making the said claim." I started belittling to him his position, and making light of his prospects and saying: " O King what is there in this affair of his to give you anxiety? His position is less than has been reported to you." But he began not to heed my words and said: " Give me information about his position in reply to what I am going to ask of you." I answered: ' Ask what seems good to you " He enquired: " How stands his lineage among you?" I said · " Pure stock: he is of our best line." " Tell me," said he, " used any of his kin to utter such things as he, so that he is now imitating such a one?" I replied: " No." He asked " Has he any property among you of which you have robbed him, and he has devised this tale that you might restore him his property?" I answered: " No." He next said: " Tell me of the followers he has among you. Who are they?" I replied: " The weak, the lowly, youngsters and women. But as to persons of mature age and of degree among his people, none of them has followed him." Then he said: " Tell me. do his followers love him and cleave to him, or do they hate him and forsake him?" I answered: " None that does follow him after forsakes him " " Tell me," he asked, " how stands the feud between him and you?" I made reply: " It has varying fortunes, now he is made to prevail over us, and now we over him." He next said: " Tell me, does he behave treacherously?" Abū Sufyān here interposes: I found nothing in his interrogatory I could find fault with him for save this. I answered: ' No, and we have a truce with him, and are not secure against treachery on his part " Now I swear Heraclius did not heed these last words of mine, but repeated to me our conversation as follows: " I asked you how stood his lineage among you, and you said he was of ' pure stock, of your best line'; and thus it is God takes his prophets; when he does take one, he takes him only from the best line of his poeple. And I enquired of you whether any of his kinsmen used to utter such things as he, so that he is now imitating him, and you answered " No " And I asked you whether he has any property among you of which you have robbed him. and he has devised this tale seeking to get back thereby his property, but you replied: " No." I then asked you about his followers, and you stated that they were ' the weak, the lowly, youngsters, and women'; now just so is it with the followers of prophets in every age. And I enquired of you whether those who follow him love him and cleave to him. or hate him and forsake him, and you answered: 'None who follows him forsakes him'; now just so is the joy of faith—it does not enter the heart of a man and then leave it. I next asked of you whether he is treacherous, and you said, " No"; so if you have told me truly of him he must surely win from me this soil I stand on, and I would feign be with him and wash his feet Go now your way." Then I rose up from beside him, beating my hands together (in woe) and saying : "Ye servants of God, the affair of the son of Abu Kabshah (i.e. Muḥammad) is grown a matter of dire import, for the kings of the Banū'l-'Aṣfar (i.e. the Byzantines) have come to hold him in awe in their own dominion of Syria" (Ṭab., I, 1561–5, *'Agh*., VI, 94–5)

Apparently soon after this incident there was brought to him the missive of Muḥammad by Diḥyah : its content was : 'In the name of God most merciful! From Muḥammad the Apostle of God to Heraclius King of Byzantium. Peace be on them who follow the right guidance!—To proceed to the matter in hand : Turn Muslim, so shalt thou be safe ; turn Muslim, and God will reward thee doubly ; but if thou turn away, the sin of the tillers of the soil be on thy head!" (i.e. the bearing the load of such sin) ; (Tab., I, 1565 : cf. *'Agh.*, VI, 95) ; it is taken to mean that the responsibility for the non-conversion to Islām of the subjects of Heraclius would be on his head.

The narratives are in general accord as to the favourable reception the missive had of the Emperor : he put it carefully away on his person (Ṭab., I 1565, *'Agh*., VI, 95) ; he is said to have called a meeting of his generals and advocated acceptance of Islām, but when he realised his proposal was displeasing to them he explained that he had but intended by it to test their steadfastness in their Christian faith (Ṭab. I, 1566, *'Agh.*, VI, 96) ; it is also said that he declared to Diḥyah his belief in Muḥammad as the prophet of their expectations, mentioned in their Scriptures, but from fear of his own Byzantine people he could not follow him : he referred him however to Bishop Ḍaghāṭir,[1] whose influence and power were greater than his own. When the latter learned orally from Diḥyah of the missive sent to Heraclius and of the faith to which he called him, he said : 'My oath upon it, your master is a prophet sent (of God) : we recognise him from his description, and find him mentioned by name in our Scriptures." Then doffing his black vesture and donning white, he went forth staff in hand to the Byzantines assembled in the church and declared : 'O assembly of Byzantines, a missive is come from Aḥmad in which he calls us unto God,—Be he exalted and glorious!—and I do witness that there is no deity save God and that Aḥmad is his servant and his apostle" Whereupon, it is recorded, they sprang on him as one man, and beat him to death. Diḥyah returned and related the incident to the Prophet (Ṭab., I, 1567). Apparently soon after Heraclius set out from Syria for Constantinople (Ṭab., *ib.*).

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[1] Ḍaghāṭir or Ḍughāṭir has not yet been identified. In a collection of letters of Muḥammad made by Ibn Sa'd there is one purporting to be written by him to Ḍaghāṭir himself, containing a declaration of his belief in prophets sent in time past, etc. It is said to have been delivered to him by Diḥyah b. Khalīfah al-Kalbī (Caet., I, 733, n. 2).

The narrative lacks little in verisimilitude; the first, and perhaps the only serious, question that suggests itself is whether it is likely that Heraclius flushed with triumph and controlled by an impulse of gratitude to his God who had led his armies to victory, is likely to have been so sorely shaken by a report that as yet threatened no peril to his empire newly confirmed by the sword.

But unfortunately for the plausible tale it has to contend with two difficulties, of a narrative order and of a chronological.

The account in Ibn Sa'd, e.g varies almost in toto from that given at length above. It is very brief merely informs us that the Prophet wrote to the Emperor calling him unto Islām, and sent his letter by Diḥyah al-Kalbī bidding him make it over to the Lord of Buṣrā, who should then make it over in turn to the Emperor, and the Lord of Buṣrā duly fulfilled his charge (Ṭabaqāt, IV, I, 185). In another tradition it is further stated that he made over the letter to the Emperor in Ḥimṣ in Muḥarram of the 7th year of the Hijrah (*ib.*).

The narrative as found in Bukhārī (I, 7–9. ed. Krehl) is somewhat similar in its account of the summons before the Emperor in 'Īliyā' of Abū Sufyān and his fellow-traders of Quraysh, who taking advantage of the Truce had resumed their interrupted calling, and also in its interrogatory to the story as given above by Ṭabarī; Heraclius was, it is added, an astrologer and the stars in their courses had been the source of his anxiety and alarm in 'Īliyā' (Bukh., I, 9). The remainder of the story has closer affinity with Ibn Sa'd, inasmuch as the letter committed by the Prophet to Diḥyah had been made over to the Lord of Buṣrā, who made it over in turn to Heraclius; the tenor of the letter is much the same, but the wording is different, though here notice need be taken only of the form *'akkārīn* occurring in the phrase "the sin of the tillers of the soil be on your head," a word which had evidently troubled the copyist of the *'Aghānī* who read it as *'akābir*, and is variously reproduced as *ḥarrāthīn*, *fallāḥīn* and *rakūsiyyīn* in other writers (*'Umdatu 'l-Qārī'*, I, 103, Const.), and is here given as *yarīsiyyīn* (Bukh , I, 8), and *'arīsiyyīn* (*ib.*, II, 235)

A narrative of this embassy to Heraclius, based on the various sources, with a bibliography of the latter, is to be found in Caetani's Annali dell' Islam, I, 731–4, in n. 3, p 734, of which the date of Heraclius' pilgrimage to Jerusalem is given as the spring of 629 A.D., whereas Dhu' l-Ḥijjah of 6 A.H. given in the Muhammadan records quoted above as the date of the despatch of Diḥyah and the other envoys falls in April of 628 A.D., i e. there is about a year's discrepance in the correspondence of the reckoninig. Undoubtedly actuality has miscarried in the case of this alleged relation between the Prophet and Heraclius. Imagination has fondly dwelt on this incident, and on those leading up to the final dénouement of the Byzantine empire in Syria in 15 A.H , and the tragic retreat of the Emperor of broken fortunes to Constantinople, and has informed the former in symmetry with the latter. "Quite recently," says Huart, "there has been a tendency to cast doubt on the reality of these embassies (from Muḥammad to neighbouring rulers), which would be only pure legends, arising out of the desire of Christians lately converted to Islām to lay before Muḥammad projects of a universal religion, and by the dispatch of these missions to liken him to Jesus, and to his disciples setting forth to carry the good news into all the world. The historical sources are as always uncertain and inadequate; Ibn Hishām gives a list of these embassies, but does not base them on the authority of Ibn-Isḥāq , Ṭabarī, it is true, quotes Ibn-Isḥāq but it is noted,—and this creates doubt within us, that the redaction of Ibn-Isḥāq which he has used is more recent and richer in apocryphal traditions than that of Ibn Hishām (*Hist d. Arabes,* I, p. 154).

Probably in the course of Muḥarram (Caet., II, I, p. 9) of the 7th year of the Hijrah commenced the campaign of Khaybar, and of the fortresses which there fell into the hands of the victorious adherents of Islām Ibn Abī'l-Ḥuqayq's stronghold of Qamūs (Nizar, Caet. II, 20) was noted for the fair captives it yielded, Ṣafiyyah daughter of Ḥuyaiyy b 'Akhtab and wife of Kinānah b al-Rabī' b. Abī' l-Ḥuqayq an Naḍarī, and her two companions, daughters of her paternal uncle. Diḥyah would feign have had possession of the Jewess Ṣafiyyah and had approached the Prophet in that connection, but yielded her up to the latter on learning that he had reserved her as his own, and received instead her two cousins (Ibn H., 758).

After the demise of the Prophet he again figures in the list of warriors, though he never rose to a superior command When Damascus had been added to the number of Muslim victories (14 A.H.), Yazīd b Abī Sufyān was installed there as military commander, and from that centre sent out expeditionary forces to the neighbouring districts not yet under subjugation. Diḥyah was placed in charge of a force of cavalry and dispatched to Tadmur (Palmyra), which readily accepted the same terms of peace as those with Damascus (Ṭab., I, 2154; Caet., III, 498).

Yet again he appears in the rôle of a junior commander; at the Battle of the Yarmūk in 15 A.H., he was given charge of one of the squadrons of cavalry which under Khālid b. Sa'īd had fled at Marju's-Ṣuffar (Muḥarram, 14 A.H.; Ṭab., I, 2093; Caet., III, 567); for the fixation of the latter date, see Caet., III, 320.

He is stated to have survived till the days of the Khalīfah Mu āwiyah (r. 41–60 A.H.; Tab., III, 2349; Ibn. S., IV, 1, 185), but of the details of his latter days nothing is preserved. The possession of his mortal remains is disputed by four lands. Nawawī says that he settled in Al-Mizzah, a village in the vicinity of Damascus (p 240). Yāqūt (*Mu'jamu l-Buldān*, IV, 522) mentions it as a large and populous village, situated in the midst of gardens, at a distance of half-a-parasang from Damascus, and that it is reputed to contain the grave of Diḥyah al-Kalbī, the friend of the Prophet; the village is known as Mizzatu-Kalb, and its name has been preserved in the lines of 'Ubaydu'l-lāh Ibn Qays ar-Ruqayyāt:—[1]

Jolly my night in Mizzatu-Kalb,
The bores clean vanished from me! [2]
I was plied, in company of Maṣād,
—Leal friend of gentlemen and me—
With Maqadī,[3]—a beverage God lawful
Made, wine being forbidden me.
Gracious daughters of men beside,
Love for Ibn Qays their guide to me.[4]

Ash-Shajarah, Yāqūt states, a village in Palestine, likewise claims to have the grave of Diḥyah al-Kalbī, which is said to be in a cave where rest eighty martyrs for the faith, but waives responsibility by adding "God knows best" (*ib.*, III, 260).

As already stated, Sam'ānī is authority for Diḥyah's residence in Egypt; tradition goes further and assigns to him a grave in Al-Qarāfah (Yāqūt, IV, 555), a quarter of Fusṭāṭ (*ib.*, p. 48). The latter place is two miles south of Cairo, and "had been the capital of the country from the time of the Mohammedan conquest. Its name is the Latin word *Fossatum* "an entrenchment," and it was the camp of the conquering army which, under Amr son of al-As, had wrested Egypt from the Byzantine empire, and which was made the seat of government because the Caliph of the time would have no water between his capital, Medinah, and any Islamic city" (Margoliouth's *Cairo*, etc., p. 2).

The fourth tradition has little to support it The *Haft Iqlīm*, the topographico-biographical work of Amīn Aḥmad of Ray (*Haft Iqlīm* was completed in 1002 = 1593 A.D.) categorically declares that the "grave of Diḥyah al-Kalbī, by reason of whose efforts much of Fārs was conquered, is in Dārābjird," [5] a town near Persepolis. It is not impossible that Diḥyah should have gone thither with the armies of the Khalīfah Uthmān (r. 23-35 A.H.) and been present when Dārābjird was taken (27 A.H.), but evidence is wanting.

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[1] For his *Dīwān*, ed. and transl. by N. Rhodokanakis, see *Sitzb. d. k. Akad. d. Wiss.* in Wien, B. CXLIV (1902).

[2] Cf. Rhodo., *ib.*, No. LVII, p. 245, v. 3: "wo der Teufel das Heizen geholt hatte."

[3] Said to be a preparation of honey.

[4] Rhodo., *ib.*, p. 246, v. 6, reads المرشقات, which has the advantage of being idiomatic.

[5] *Haft Iqlīm*, under section on *Fārs*.

The following ḥadīth are quoted from him :—

(*a*) The Apostle of God (صلعم) brought pieces of fine Egyptian linen, and gave me a piece saying : " Tear it in two, and cut out a tunic of one for yourself, and give the other to your wife to make into a head-covering." As he turned away he said : " Bid your wife put another cloth under it so as not to display her " (Abū Dā'ūd, *K. al-Libās*).

(*b*) Another is found in Aḥmad b. Muḥammad b. Ḥanbal's *Musnad* (IV, 311, Cairo) :—

حدثنا عبد الله حدثني أبي ثنا محمد بن عبيد ثنا عمر بن آل حذيفة
عن الشعبي عن دحية الكلبي قال قلت يا رسول الله ألا أحمل لك حماراً على
فرس فينتج لك بغلاً وتركبها قال انما يفعل ذلك الذين لا يعلمون *

21. A Note on the Jāṅgala Desa.

By KUMAR GANGANANDA SINHA, M.A.

Numerous references are found in the Epics to Jāṅgala and to the people of Jāṅgala (Jāṅgalāh). But it is yet to be determined what the Jāṅgala country or countries were. Sometimes the word Jāṅgala occurs alone and sometimes in compounds like Kuru Jāṅgalāh, Mādreya-Jāṅgalāh.

Pandit Gaurisankar Hirachand Ojha in one of his recent articles in the Nāgari Prachāriṇī Patrikā (Vol. II, Part 3), entitled राजपूताने के भिन्न भिन्न विभागों के प्राचीन नाम (Ancient names of the different parts of Rajputana), contends that this name was applied to the modern Bikanir State and the northern part of Marwar, including Nagour and other Pergannas. But I am afraid that his contentions do not bear scrutiny.

Let us first examine what the word " Mādreya-Jāṅgalāh " means. There can be no two opinions as to the fact that it means the people of Jāṅgala belonging to Madra. The Madra country had its capital at Sākala, which is admitted by scholars to be the same as modern Sealkot (in North Punjab). Now if we agree with the learned Pandit and take Jāṅgala to mean Bikanir State and Marwar we can by no stretch of imagination connect it with the Madra country or the people of Madra who occupied a country far towards the north. As a matter of fact they were so wide apart that they cannot have been contiguous countries.

Similarly a careful study of the Epics will show it beyond doubt that " Jāṅgala " in " Kuru-Jāṅgalāh " would never have been the Bikanir and Marwar States.

Describing the route from Ayodhyā to Kekaya (beyond the Beas) the following verse (13) of the Rāmāyaṇa occurring in the Ayodhyā Kāṇḍa, Chap. 68, seeks to locate the Kuru-Jāṅgala country.

TE HASTINĀPURE GAṄGĀM TĪRTVĀ PRATYANGMUKHĀ
YAYUH.
PĀṄCHĀLA DEŚAMĀSĀDYA MADHYENA KURUJĀṄGALAM.

(Trans.—They went westward after having crossed the Ganges at Hastināpura and after having passed through (literally—reached) Pānchāla Deśa, and Kuru-Jāṅgala in the middle.)

The Kuru-Jāṅgala country must therefore have been between the Pānchāla Deśa and the Ganges.

Again, the following references to the Mahābhārata unmistakably show that the Kuru-Jāṅgala country formed a part of the Kuru kingdom.

TESHU TRĪSHU KUMĀRESHU JĀTESHU KURUJĀṄGALAM.
KURUVOTHA KURUKSHETRAM TRAYAMETAD AVARDHATA.

Adi—Ch. 109-1,

(Trans —By the birth of the three princes all the three, Kuru, Kurukshetra, and Kuru-Jāṅgala, increased.)

This clearly shows that the Kuru kingdom was divided into three parts of which Kuru-Jāṅgala was one.

VIRASŪNĀM KĀSISUTE DEŚĀNĀM KURUJĀṄGALAM.
SARVA-DHARMA-VIDĀM BHĪSHMA PURĀṆĀM GAJASĀH-VAYAM.

Adi—Ch. 109-24.

(Trans.—Of the progenitors of heroes the daughter of (the king of) Kāśī, of the countries Kuru-Jāṅgala, of all the people versed in righteousness Bhīshma, of all the cities Gajasāhvaya)

Kuru-Jāṅgalam will be irrelevent in the above verse if it does not mean a country under the Kurus.

To substantiate my statement further I shall quote one of those verses that are cited by the learned Pandit in support of his contentions.

TATAH KURUSRESHṬHAMUPAITYA PAURĀH PRADAKSHINAM CHAKRURADĪNASATVĀH.
TAM BRĀHMAṆĀSCHĀBHYAVADAN PRASANNĀ MUKHYĀSCHA SARVE KURUJĀṄGALĀNĀM.

Vana—Chap. 23-5.

(Trans.—The citizens, rich in might, and all the principal persons of the Kuru-Jāṅgala people then cheerfully encircled the head of the Kurus, who was being greeted by the Brāhmaṇas.)

Why would the people of the Kuru-Jāṅgala country have paid homage to the Kuru chief if they had not been his subjects.

Again, in the Vanaparva we find the following verse :—

TĪRTHAYĀTRĀMANUKRĀMAN PRĀPTOSMI KURUJĀṄGALAM
YADRICHCHHAYĀ DHARMARĀJAM DRISHTAVĀN KĀMYAKE VANE.

Vana-Chap. 10-11.

(Trans.—Going on pilgrimage I of my own accord reached the Kuru-Jāṅgala country and saw Dharmarāja in the Kāmyaka forest.)

It signifies that the Kāmyaka vana was in the Kuru-Jāṅgala country.

Now we find the location of the Kāmyaka vana from the following verse :—

TATAH SARASWATĪKULE SAMESHU MARUDHANYASHU
KĀMYAKAM NĀMA DADRISHU VANAM MUNIJANAPRIYAM.

Vana—Chap. 5-3.

(Trans.—Then on the bank of the Saraswati near the barren waste they saw the forest named Kāmyaka which was liked by hermits.)

It signifies that the Kāmyaka forest lay just on the bank of the Saraswatī. The Kuru-Jāṅgala country therefore extended as far as the eastern banks of the Saraswati and not beyond it. The "Marudhanyashu" of the verse cannot be taken to mean the whole of the deserts of Rajputāna including Bikanir. As a matter of fact the Kuru country lay far to the north-east of Bikanir.

The learned Pandit further wants us to believe that the capital of Jāṅgala Desa was Ahichchhatrapur and he identifies it with modern Nagour (in the northern part of the Jodhpur State.) But unfortunately the evidence which he has adduced is not at all convincing.

The mere fact that both Nāgapur (which the Pandit derives from Nāgour,) and Ahichchhatrapura denote 'the city of serpents' cannot prove their identity. Far from it, we know from the great Epic that Ahichchhatrapura was the capital of the North Pañchāla. Jnānachandra, 'the *guru* of Col. Todd,' whose index of 25 names, among which Ahichchhatrapura is spoken of as the capital of Jāṅgala Desa, has been relied upon by the learned Pandit, can never satisfy a critical mind. We know that Jnānachandra belongs to a very late date and taken alone, his account of something belonging to antiquity cannot be deemed trustworthy. Apart from these facts we cannot admit that Jāṅgala Deśa of the Epics was modern Bikanir State and Marwar, merely by the fact that in their family ensign the Maharajas of Bikanir style themselves "Jaṅgaladhara Bādashāha."

Now, what appears to be a fact is that we should not take Jāṅgala Desa to mean a particular tract of land. We should rather take it in its literal sense signifying Jaṅgala settlement in general. In Bate's Hindi Dictionary "Jaṅgala" means a *forest, wood, waste, desert, weeds.* These "Jaṅgala settlements" were sometimes named differently to distinguish them from one another according as they were attached to one country or the other. It is only by taking them in this sense that we can understand the true import of words like Kuru-Jāṅgala, Mādreya-Jāṅgala.

22. On the Theory of Generalised Quanta and the Relativistic Newtonian Motion.

By S. C. Kar.

The general theory of the quantaic structure of phase-space has been given by Planck in the Annalen der Physik.[1] This structure depends on the integrals of the motion and in $2f$-dimensional phase-space the elementary cell has according to Planck a volume equal to h^f, where h is Planck's constant. Rules are also given depending on what Planck has called coherence or incoherence of co-ordinates which determine the splitting up of the single quanta condition respecting the volume of the cell into f different conditions respecting the f (q, p)-planes.

In the next volume of the Annalen[2] somewhat different conditions are laid down by Sommerfeld. According to Sommerfeld the elementary volume $\int dq_1 dp_1 \ldots dq_f dp_f$ of phase-space may be regarded as determined by the f-projections

$$\int dq_1 dp_1, \int dq_2 dp_2, \ldots \int dq_f dp_f \text{ on the } f\ (q, p)\text{-planes.}$$

Each of these integrals is then integrated with respect to p and then Sommerfeld proceeds to write—

$$\int p_1 dq - \int p_0 dq = h,$$

$$\int p_2 dq - \int p_1 dq = h,$$

$$\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot$$

$$\int p_n dq - \int p_{n-1} dq = h.$$

$$\therefore \quad \int \left(p_n - p \quad\right) dq = nh.$$

Assuming now that of the group of curves on the (q, p)-planes a path may be obtained such that along it $\int p_0 dq = 0$, Sommerfeld gets the simplified form $\int p_n dq = nh$. For the limits of integration he gives the rule that it should be performed over that length of the orbit which brings up fresh phases in phase-space so that in periodic orbits the integration is over one complete cycle. In Newtonian orbits of the relativistic type or other quasi-periodic orbits, where there is a regular forward or backward motion of the perihelion, this means a path of integration for $\int p_r dr$ from r_{min} to r_{min} through r_{max}, or what amounts to the same thing, double the path from r_{min} to r_{max}. For the azimuthal phase-integral $\int p_\phi d\phi$ the path is taken to be just one cycle of 2π and not from r_{min} to r_{min} through r_{max}. The reason for this variation, as given by Sommerfeld, seems to be that attention should be directed not so much to the actual orbit as to its counterpart in phase-space and since an ellipse of a given size may have any position as regards the azimuth of its perihelion and since the whole set of such ellipses should be taken into account, all phases are comprehended in a path of integration from 0 to 2π. The results obtained from these quanta conditions taken along with Bohr's famous rule for the frequency of the emitted radiation receive startling confirmation in the experimental results of Paschen on the Balmer lines of hydrogen. The behaviour of the Rydberg number and of doublets and triplets is as near as might be expected to the predictions of the formula.

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[1] *Ann. d. Phys.* L, p. 385 (1916).
[2] *Ann. d. Phys.* LI, p. 1 (1916).

It is at once possible, however, to raise certain theoretical objections to Sommerfeld's theory. In the first place the elementary volume $\int dq_1 dp_1 \,..\, dq_f dp_f$ which is h^f after Planck cannot be represented as $\int dq_2 dp_2 \,.\int dq_2 dp_2 \ldots \int dq_f dp_f$. This objection is met partially if on the authority of Epstein and Schwarzschild—and to this Sommerfeld agrees—the choice of the coordinates is determined by the possibility of separation of the variables in the Hamilton-Jacobi equation. If such separation can be effected we should have according to Staeckel—at least in regard to a Staude-Staeckel dynamical system—p_1 a function solely of q_1. The limits for $q_1\, q_2 \,..\, q_f$ still remain interdependent and this disposes of the possibility of the latter mode of representation even when the choice is made after Epstein's rule.

Secondly the reasoning which Sommerfeld adduces in support of the path of integration for the azimuthal phase-integral appears to be far from convincing. It goes too far and would indicate an identical path of integration for the phase-integral $\int p_r dr$. On the other hand having in view the concepts of the time-total (Zeitgesamtheit) of phases and of the space-total (Raumgesamtheit) of phases employed in statistical mechanics and the proposition[1] that the time-total of phases of a single orbit is equal to the space-total of phases of all similar orbits we should rather have the path of integration extended over the complete cycle from r_{min} to r_{min} through r_{max}, seeing that although p_ϕ is constant the phase-point in phase-space does not come back to itself until starting from r_{min} we come back to r_{min} through r_{max}.

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[1] *Ganz und Weber: Repertorium der Physik*, p. 455 (1916).

A third objection to Sommerfeld's treatment of the relativistic motion is that advanced by Planck and Schwarzschild also in regard to the azimuthal phase-integral. According to Sommerfeld himself the integral $\int dqdp$ is reducible to the form $\int p_n dq = nh$ only when a path may be obtained such that along it $\int p_0 dq = 0$. This however is not possible owing to a minimum value of the angular momentum which cannot be passed if the elliptic motion is preserved. Planck in his own treatment of the relativistic motion arrives at the result $2\pi\ (p_n - p_0) = nh$ as the azimuthal condition where p_0 is the limiting value of the angular momentum. The behaviour of the Rydberg number in the experimental results of Paschen, however, tells in favour of $2\pi p_n = nh$.

In the present paper I shall venture to suggest a fresh standpoint in regard to quanta conditions and to develop it by reference to the particular cases of (*i*) the linear oscillator, (*ii*) the rotator, (*iii*) the ordinary Newtonian ellipse and (*iv*) the relativistic Newtonian ellipse. While they meet all the objections stated against Sommerfeld's theory they give results identical with those of Planck and Sommerfeld in the first three cases. The results obtained, however, in the case of the relativistic ellipse are at variance alike with those of Planck and of Sommerfeld as well as with those which Sommerfeld would have if he took the path of integration for the azimuthal phase-integral (as he at first did) from r_{min} to r_{min} through r_{max}. The central idea in this investigation is still that of Planck namely the structure of phase-space must be on the basis of the integrals of the motion. As regards the experimental aspects of these conditions I have to admit the disappearance of the doublets and triplets but the behaviour of the Rydberg number may be deemed to be far from discouraging.

ONE DEGREE OF FREEDOM. LINEAR OSCILLATOR, ROTATOR.

We may write the quanta condition in the form

$$\int\oint dt\,.\,\delta H = nh \quad \text{or} \quad \int T\delta H = nh$$

where H is the energy and T is the periodic time.

(*a*) Linear oscillator.

The equation of motion is $\ddot{x} + \mu^2 x = 0$; $\therefore$ $\dot{x}^2 + \mu^2 x^2 = \text{const.}$ $= 2H$ (twice the energy) $= \mu^2 a^2$ when a is the amplitude. $T = \frac{2\pi}{\mu}$; therefore T is independent of H, μ^2, which is the constant of the elastic force, being an absolute constant not liable to variation from one oscillator to another. We therefore have $T(H_n - H_0) = nh$ or if $H_0 = 0$, $TH_n = nh$. In the usual notation ϵ_n (the energy) $= \frac{nh}{T} = nh\nu$ (where ν is the frequency).

(*b*) Rotator. The integral of energy is $\frac{1}{2}J\omega^2 = H$ where J is the moment of inertia and ω the angular velocity.

$$T = \frac{2\pi}{\omega} = \frac{\pi\sqrt{2J}}{H^{\frac{1}{2}}}.$$

$$\therefore \qquad \int_0^n T\delta H = \Big|_0^n \pi\sqrt{2J}\,.\,2\,.\,H^{\frac{1}{2}} = nh\,; \text{ if } H_0 = 0,$$

we have

$$H_n = \frac{n^2h^2}{8\pi^2 J}.$$

TWO DEGREES OF FREEDOM. THE ORDINARY NEWTONIAN ELLIPSE.

We may write the quanta condition in the forms

$$\int\oint dt\,.\,\delta H = nh \quad \text{and} \quad \int\oint d\phi . \delta p_\phi = n'h$$

or in the alternative forms

$$\int_0^n T\delta H = nh \quad \text{and} \quad \int_0^{n'} \Phi\delta p_\phi = n'h,$$

where p_ϕ is the angular momentum and Φ is the azimuthal period which, in the present case, is equal to 2π.

The energy $H = -E = \frac{1}{2}\left\{m(\dot{r}^2 + r^2\dot{\phi}^2) - \frac{2e^2}{r}\right\}$ and the angular momentum $= p = mr^2\dot{\phi}$.

The periodic time T is obviously a function entirely of the energy because both are functions of the major axis. It may however be conveniently found directly in terms of the energy.

$$\left(\frac{dr}{dt}\right)^2 = \frac{2e^2}{mr} - \frac{p^2}{m^2r^2} - \frac{2E}{m}$$

$$\therefore \quad T = 2\int_{r_{min}}^{r_{max}} \frac{rdr}{\sqrt{\frac{2e^2}{m}r - \frac{p^2}{m^2} - \frac{2E}{m}r^2}}\,.$$

$$= \sqrt{\frac{2m}{E}} \int_{r_1}^{r_2} \frac{rdr}{\sqrt{(r_2 - r)(r - r_1)}} \quad [r_2 = r_{max},\ r_1 = r_{min}\ ]$$

$$= \pi\sqrt{\frac{m}{2}} \cdot \frac{e^2}{E^{\frac{3}{2}}}\,.$$

$$\therefore \quad nh = \int_0^n T\delta H = -\pi e^2 \,.\, \sqrt{\frac{m}{2}} \,.\, \int_0^n \frac{\delta E}{E^{\frac{3}{2}}} = \pi e^2 \,.\, \sqrt{2m} \,.\, E_n^{-\frac{1}{2}}.$$

$\therefore \quad H_n = -E_n = -\dfrac{2m\pi^2 e^4}{n^2h^2}$; which is in perfect accord with Sommerfeld's expression $-\dfrac{2m\pi^2 e^4}{(n+n')^2h^2}$ if it is noticed that the single number n really absorbs n' and stands for $n + n'$.

For the azimuthal phase-integral $\int_0^{n'} \Phi\delta p$ we have

$$2\pi p_{n'} = n'h.$$

THEORETICAL CONSIDERATIONS UNDERLYING THE PRESENT MODE OF WRITING THE QUANTA CONDITIONS.

(i) One degree of freedom; phase-integral:—

$$\int\oint dt \,.\, \delta H.$$

In integrating with respect to t over the whole period it is evident that we are taking account of all phases through which a particular system passes with constant energy and in so doing we are also taking the space-total of all phases which all systems with a given energy represent in phase-space. In subsequent integration with respect to H, therefore, we are accounting for the whole of phase-space corresponding to every variation of the energy. The elementary cell in this phase-space having a volume equal to h we have

$$\int\oint dt\,\delta H \text{ or } \int T\delta H = h.$$

The phase-space and the cell may be represented on a plane by Fig. I for the oscillator and by Fig. II for the rotator as follows:—

Fig. I.

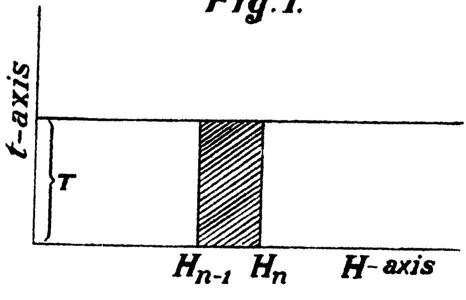
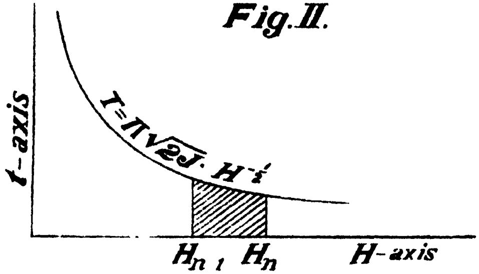


Fig. II.



(ii) Two degrees of freedom; ordinary Newtonian ellipse: phase-integrals:—

$$\int\oint dt\,.\,\delta H = h\,;\quad \int\oint d\phi . \delta p = h.$$

What has been said respecting the case of one degree of freedom will apply equally in this case to the phase-integral

$$dt\,.\,\delta H = h.$$

But fresh phases come up by reason of the fact that, keeping H and T constant, we can vary p or the azimuth. The phases brought up by variation of azimuth have no necessary relation with those depending on time-difference, for although in this case $\oint d\phi$ is an absolute constant, in the case of the relativistic ellipse it is a function of p while T is a function of H. Having regard therefore to the proposition that the space-total of phases of different systems having the same p, T, and H would be equal to the time-total of phases of a single system we integrate $\oint d\phi$ over the complete period. Subsequent integration with respect to p, therefore, accounts for all phases which can arise through these causes.

The observation may be made that the canonical coordinates p_1q_1, p_2q_2, etc., of a dynamical system are not unique and that it is easy to substitute for any group (p, q) the group (H, t). It is possible therefore to represent phase-space as determined by the system of coordinates $(p_2, q_2, p_3, q_3 \,..\, H, t)$. The elementary volume of this space would be

$$\int dq_2 dp_2 dq_3 dp_3 \,..\, dt dH.$$

In the present case this volume $= \int d\phi \delta p dt \delta H$ which can be represented as $\int d\phi \delta p \,.\, \int dt \delta H$ because p and H are independent constants while Φ and T are functions of p and H respectively This volume, therefore, is equal to h^2 as Planck should have.

POSSIBILITY OF REDUCTION OF THE PRESENT QUANTA INTEGRALS TO SOMMERFELD'S FORMS.

Writing the Hamiltonian equations of motion in the bilinear form we have

$$(dq\delta p - dp\delta q) = dt \,.\, \delta H.$$

where d refers to a variation with the time and therefore along the orbit and δ refers to a variation independent of the time. In the particular case before us

$$\left(dq_r \delta p_r - dp_r \delta q_r \right) + dq_\phi \delta p_\phi = dt \,.\, \delta H$$

because, p_ϕ being constant, $dp_\phi = 0$.

This may be put in the form

$$\delta \left(p_r dq_r \right) - d \left(p_r \delta q_r \right) + dq_\phi \delta p_\phi = dt \,.\, \delta H.$$

Integrating this form over a complete cycle we have

$$\delta \left[\oint p_r dq_r \right] - \oint \left[p_r \delta q_r \right] + 2\pi \delta p_\phi = T \,.\, \delta H.$$

Since $\oint \left[p_r \delta q_r \right] = 0$ – and this may be easily verified—therefore we may write

$$\delta \left[\oint p_r \, dq_r \right] + 2\pi \delta p_\phi = T \delta H.$$

Integrating this equation from one orbit to another we have

$$\left[\oint p_r dq_r \right]_1^2 + \left[2\pi p_\phi \right]_1^1 = \int_1^2 T \delta H$$

It is now obvious that instead of associating a quanta number with the phase-integral $\int_1^2 T\delta H$ we may associate another with the integral $\left[\oint p_r\, dq_r\right]_1^2$ which will be the difference of the quanta numbers associated with the former and with the expression $2\pi p_\phi$ and this is exactly what Sommerfeld has done.

CASE OF THE RELATIVISTIC ELLIPSE.

Phase-integrals :—

$$\int\oint dt\,.\,\delta H = nh\,;\quad \int\oint d\phi\delta p_\phi = n'h.$$

Sommerfeld writes

$$\frac{d}{dt}\cdot\left(m\dot{x}\right) = -\frac{e^2}{r}\cos\phi\,;\quad \frac{d}{dt}\left(m\,\dot{y}\right) = -\frac{e^2}{r}\sin\phi$$

where $$m = m_0/\sqrt{1-\beta^2} \text{ and } \beta = \frac{v}{c}\,.$$

Putting $K = -m_0c^2\sqrt{1-\beta^2}$ we have $\dfrac{\partial K}{\partial\dot{x}} = \dfrac{m_0}{\sqrt{1-\beta^2}}\,.\,\dot{x} = m\dot{x}$

and $$\frac{\partial K}{\partial\dot{y}} = m\dot{y}.$$

The equations of motion are therefore deducible from

$$\delta\int(K-V)dt = 0, \text{ where } V \text{ is the potential } -\frac{e^2}{r}\cdot$$

The angular momentum $\dfrac{\partial K}{\partial\dot{\theta}} = \dfrac{m_0}{\sqrt{1-\beta^2}}\,.\,r^2\dot{\theta} = mr^2\dot{\theta} = p.$

The integral of energy may be found thus;

$$\delta\int_1^2 (K-V)\,dt = \int_1^2\left(\frac{\partial K}{\partial\dot{x}}\delta x + \frac{\partial K}{\partial\dot{y}}\delta y\right)$$

Regarding the upper limit variable and δ a variation along the orbit we have

$$K - V = \dot{x}\frac{\partial K}{\partial\dot{x}} + \dot{y}\frac{\partial K}{\partial\dot{y}} - \text{const. (energy)},$$

or $$H = \dot{x}\frac{\partial K}{\partial\dot{x}} + \dot{y}\frac{\partial K}{\partial\dot{y}} - K + V$$

$$= \frac{m\,c^2}{\sqrt{1-\beta^2}} - \frac{e^2}{r}.$$

For the bilinear form of the Hamiltonian equations we proceed as follows :—

Let $$\int_1^2 (K-V)\,dt = S$$

$$\therefore \qquad \delta S - \Big|_1^2 (K-V)\delta t = \Big|_1^2 \left\{ \frac{\partial K}{\partial \dot{x}} (\delta x - \dot{x}\delta t) + \frac{\partial K}{\partial \dot{y}} (\delta y - \dot{y}\delta t) \right\}$$

δ being any arbitrary variation,

$$\therefore \qquad \delta S = \Big|_1^2 \left\{ \frac{\partial K}{\partial \dot{x}} \delta x + \frac{\partial K}{\partial \dot{y}} \delta y - H\delta t \right\},$$

$$= \Big|_1^2 (\Sigma p\delta q - H\delta t),$$

$\therefore$ if Δ be another arbitrary variation

$$\{ \Sigma(\Delta q\delta p - \Delta p\delta q) \}_1^2 = \{ \Delta t\delta H - \Delta H\delta t \}_1^2 .$$

If the variation Δ represents one with time and if the lower limit refers to a definite epoch we have in the case before us

$$(dq_r\delta p_r - dp_r\delta q_r) + dq_\phi\delta p_\phi = dt\delta H$$

i.e. $$\delta(p_r dq_r) - d(p_r\delta q_r) + dq_\phi \,.\, \delta p_\phi = dt \,.\, \delta H.$$

Now, the differential equation of the orbit has been deduced by Sommerfeld in the form

$$\frac{d^2\sigma}{\partial\phi^2} + \sigma\left\{1 - \frac{e^4}{p^2c^2}\right\} = \frac{m_0e^2}{p^2}\left\{1 + \frac{H}{m_0c^2}\right\},$$

and the equation to the orbit in the form

$$\sigma = A(1 + \epsilon\cos\gamma\phi), \text{ where } \sigma = \frac{1}{r},$$

$$A = \frac{m_0e^2}{p^2\gamma'}\left(1 + \frac{H}{m_0c^2}\right), \; \gamma^2 = 1 - \frac{e^4}{p^2c^2}.$$

ϵ is given by the relation which is easily deduced

$$1 + \frac{H}{m_0c^2} = \sqrt{\frac{p^2 - p_0^2}{p^2 - \epsilon^2 p_0^2}} \quad \text{where } p_0 = \frac{e^2}{c}.$$

The azimuthal period $=\dfrac{2\pi}{\gamma}$; therefore the phase-integral

$$\int_0^{n'}\oint d\phi\,\delta p_\phi=\int_0^{n'}\frac{2\pi}{\gamma}\,.\,\delta p$$

$$=2\pi\int_0^{n'}\frac{p\,\delta p}{\sqrt{p^2-p_0^2}}=\Bigg|_0^{n}\,2\pi\sqrt{p^2-p_0^2}\,\Bigg|$$

$$2\pi\sqrt{p^2-p_0^2}=n'h.$$

For the phase-integral $\displaystyle\int_0^{n}\oint dt\,\delta H$ we integrate the bilinear form over the whole orbit and obtain

$$T\delta H=\delta\oint p_r\,dq_r-\oint\Big[p_r\,\delta q_r\Big]+\frac{2\pi}{\gamma}\,.\,\delta p$$

But $$\oint\Big[p_r\,\delta q_r\Big]=\Bigg[\frac{p}{m_0\sigma^2}\sqrt{1-\beta^2}\,\frac{\partial\sigma}{\partial\phi}\Bigg\{-\frac{\delta A}{A^2(1+\epsilon\cos\gamma\phi)}$$

$$-\frac{\delta\epsilon\cos\gamma\phi}{A(1+\epsilon\cos\gamma\phi)^2}+\frac{\epsilon\sin\gamma\phi}{A(1+\epsilon\cos\gamma\phi)^2}\phi\,.\,\delta\gamma\Bigg\}\Bigg]_0^{\frac{2\pi}{\gamma}}=0.$$

$$\therefore\quad T\delta H=\delta\Big[\oint p_r\,dq_r+2\pi\sqrt{p^2-p_0^2}\Big].$$

Sommerfeld evaluates

$$\oint p_r\,dq_r=2\pi\sqrt{p^2-p_0^2}\left\{\frac{1}{\sqrt{1-\epsilon^2}}-1\right\},$$

$$\therefore\quad T\delta H=\delta\left[2\pi\sqrt{\frac{p^2-p_0^2}{1-\epsilon^2}}\right],$$

But $$1+\frac{H}{m_0c^2}=\sqrt{\frac{p^2-p_0^2}{p^2-\epsilon^2p_0^2}}=\sqrt{S}\ \text{(say)}$$

from which we obtain

$$\frac{p^2-p_0^2}{1-\epsilon^2}=\frac{Sp_0^2}{1-S}.$$

$$\therefore\quad\int_0^{n}T\delta H=2\pi\left(\frac{S_np_0^2}{1-S_n}\right)^{\frac{1}{2}}=nh\quad\therefore\quad S_n=\frac{n^2h^2}{n^2h^2+4\pi^2p_0^2}$$

or $$1+\frac{H_n}{m_0c^2}=\frac{nh}{\sqrt{n^2h^2+4\pi^2p_0^2}}$$

It will be seen that the energy thus depends on a single quanta number and the doublets and triplets of the Balmer series would receive no explanation.

COMPARISON WITH THE QUANTA PROPOSITIONS OF PLANCK AND SOMMERFELD.

Sommerfeld writes

$$2\pi\sqrt{p^2 - p_0{}^2}\left\{\frac{1}{\sqrt{1-\epsilon^2}} - 1\right\} = nh$$

and $2\pi p = n'h$, while with Planck the latter would be in the form $2\pi(p - p_0) = n'h$. According to Sommerfeld's original view of the path of integration for the azimuthal integral the latter would stand in the form

$$\frac{2\pi}{\sqrt{p^2 - p_0{}^2}} \cdot p^2 = n'h.$$

All these relations are therefore different from the relation

$$2\pi\sqrt{p^2 - p_0{}^2} = n'h$$

proposed in this paper while if the present relation is admitted then the radial quanta number of Sommerfeld would appear to be a simple difference of the quanta numbers associated with the time-energy integral and with the azimuthal integral.

It is obvious that $\int d\phi\,\delta p\,dt\,\delta H = \int d\phi\,\delta p \cdot \int dt\,\delta H$ since the period in ϕ is a function solely of p and the period in t a function of H. Thus the volume of the elementary cell in phase-space is equal to h^2. It will also be seen that the least value of p which is p_0 cannot be passed in quanta changes.

COMPARISON WITH PASCHEN'S EXPERIMENTAL RESULTS ON THE BEHAVIOUR OF THE RYDBERG NUMBER IN THE BALMER SERIES.

We have $$\frac{H_n}{m_0c^2} = \frac{nh}{\sqrt{n^2h^2 + 4\pi^2p_0{}^2}} - 1$$

$$= \frac{nh}{\sqrt{n^2h^2 + \dfrac{4\pi^2e^4}{c^2}}}$$

But $e = 4{\cdot}7 \,.\, 10^{-10}$; $h = 6{\cdot}5 \,.\, 10^{-27}$; $c = 3 \,.\, 10^{10}$

$\frac{4\pi^2e^4}{c^2h^2}$ is of the order of 10^{-3}.

Therefore

$$\frac{H_n}{m_0c^2}=\frac{1}{\sqrt{1+\frac{4\pi^2e^4}{c^2n^2h^2}}}-1$$

$$=-\frac{2\pi^2e^4}{c^2n^2h^2}+\frac{6\pi^4e^8}{c^4n^4h^4}-\text{etc.}$$

$$\nu=\frac{H_{n_1}-H_{n_2}}{h}=\frac{m_0c^2}{h}\cdot\left\{\frac{2\pi^2e^4}{c^2n_2{}^2h^2}-\frac{2\pi^2e^4}{c^2n_1{}^2h^2}+\frac{6\pi^4e^8}{c^4n_1{}^4h^4}-\frac{6\pi^4e^8}{c^4n_2{}^4h^4}+\text{etc.}\right\}$$

$$=\frac{2\pi^2e^4m_0}{h^3}\cdot\left(\frac{1}{n_2{}^2}-\frac{1}{n_1{}^2}\right)\left\{1-\frac{3\pi^2e^4}{c^2h^2}\left(\frac{1}{n_1{}^2}+\frac{1}{n_2{}^2}\right)+\text{etc.}\right\}.$$

$$\frac{1}{\lambda}=\frac{\nu}{c}=N\left(\frac{1}{n_2{}^2}-\frac{1}{n_1{}^2}\right)\left\{1-\frac{3\pi^2e^4}{c^2h^2}\left(\frac{1}{n_1{}^2}+\frac{1}{n_2{}^2}\right)+\text{etc.}\right\}$$

where N is the Rydberg number.

The corrected Rydberg number N' therefore

$$=N\left\{1-\frac{3\pi^2e^4}{c^2h^2}\left(\frac{1}{2^2}+\frac{1}{m^2}\right)\right\}$$

for the hydrogen lines.

According to Sommerfeld

$$N'=N\left\{1+\frac{\pi^2e^4}{c^2h^2}\left(\frac{1}{2^2}+\frac{1}{m^2}\right)\right\}.$$

It will thus appear that the order of the correction proposed agrees with that of Sommerfeld's formula. There is however a difference in sign. If we observe however Paschen's experimental values[1] for H_α, H_β, H_γ, H_δ

	H_α	H_β	H_γ	H_δ
N'	109678·205	109678·164	109678·167	109678·198

it will be noticed that apart from H_α the successive numbers show an increase and not a decrease and this fact is more in harmony with the negative sign than with the positive sign of Sommerfeld's form which by making ΔN positive would necessitate N decreasing down the series.

CONCLUSION.

The extension of the theory of the present paper to a case of f degrees of freedom may be made provided we are able to find the f first integrals of the motion of which one is necessarily the integral of energy. If the corresponding positional co-ordinates are known the quanta-integrals may be written in the forms

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[1] Ann. d. Phys. vol. 50, 1916, p. 935.

$$\int_0^{n} T\delta H = nh,\qquad \int_0^{n'} \Phi\delta p_{\phi} = n'h,\qquad \int_0^{n'} \Psi\delta p_{\psi} = n''h.\ \text{etc.}$$

It is evident that a quanta-integral would tend to become infinite if the periodic time or the period of the positional coordinate is infinite, i.e. if the motion of the system in respect of that particular coordinate is not periodic. It would thus appear allowable to suggest that quantaic changes of energy- or momenta are a property of periodic or quasi-periodic motions and that in cases where there is no periodicity the energy-changes or momenta-changes must be gradual—a fact which ensures finite values for the quanta-integrals.

SUMMARY.

In this paper the suggestion has been made on theoretical grounds of statistical mechanics that the quanta integral in the case of one degree of freedom should be written in the form

$$\int_0^{n} T\delta H = nh$$

and that in the case of Newtonian elliptic motion both of the ordinary and the relativistic type quanta-integrals should be written in the forms

$$\int_0^{n} T\delta H = nh,\qquad \int_0^{n'} \Phi\delta p = n'h$$

(where T is the periodic time, H, the energy, Φ, the complete azimuthal period. and p the angular momentum). The consequences of this theory are compared with those of Sommerfeld's and with the observations of Paschen on the Balmer lines of hydrogen and it is shewn that while the doublets and triplets receive no explanation, the behaviour of the Rydberg number may be regarded as equally satisfactory if not more so.

23. Lakhīmpurī—A Dialect of Modern Awadhī.[1]

By Baburam Saksena, M.A.

CHAPTER I.

Introduction.

§ 1. The following paper treats of a dialect of Awadhī, spoken round about Lakhīmpur (Dt. Kheri) of which place the writer is a resident.

§ 2. The dialect possesses no literature It is reduced to writing only in statements recorded by the Police and the Judiciary and in written messages from one villager to another. The educated classes generally prefer literary Hindī in writing and sometimes even in speech

§ 3. The transliteration used in these pages is that of the Royal Asiatic Society of Great Britain and Ireland with the following modifications :—

e (short) as in *piyen*, *ē* (long) as in *dēkhā*,
o (short close) as in *roibā*, *ō* (long close) as in *rōwat*^{i},
ə (very short *a*) as in *dekhətiu*, ^{i}, ^{u} and ^{e} (above the line) represent very short *i*, *u* and *e* respectively as in *bipat*^{i}, *kuch*^{u}, *kāhe s*^{e},
˜ above a vowel denotes nasalisation as in *bhawãr*,
ṛ for ड़ as in *ghōṛā*, *ṛh* for ढ़ as in *laṛhī*,
w (and not *v*) represents व as in *kauwā*.

The sounds are generally those of literary Hindī.

Notes on Pronunciation.

§ 4. *a*, *i*, *u*, *e* if found at the end of a word are generally pronounced very brief almost like ə, ^{i}, ^{u}, ^{e}. Words which end in consonants generally add ə, ^{i} or ^{u} at the end, specially when the pronunciation is not rapid, e.g. *ghar* : *gharə*, *caddar* : *caddar*^{i}, *sukh* : *sukh*^{u}.

Note.—^{u} is generally added to sing. dir., ə to sing obl. and to plur. and *i* to fem. bases

§ 5. Intervocalic *h* is pronounced very lightly so much so that sometimes it seems to be absent, e.g. *mahi* : *mai* ; *h* at the end of a word is, however, fully pronounced, e.g. *ṭhanḍh* If *h* appears in two adjacent syllables it is pronounced very lightly in one of them, e.g. *rahihaũ* > *rahiaũ* or *raihaũ*.

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[1] The writer is indebted to Prof. R. L. Turner under whom he has worked as a Researcher for his kind guidance and helpful suggestions.

§ 6. Intervocalic *y* is inserted optionally between two vowels if one of them is ĭ or ĕ (e.g. *piyau* : *piau*, *gayē* : *gaē*) and *w* if the first vowel is ŭ or ŏ (e.g. *chuwaũ* : *chuaũ*, *rōwat*^{i} : *rōat*^{i}).

§ 7. Any vowel which is long in a base or root is shortened if it is more than two syllables from the end of a word when declined or conjugated. This occurs only when one of the two syllables is long or both being short, the word ends in a consonant, e.g. *dēkh* + *ihaũ* > *dekhihaũ*, *dēkh* + *ibā* > *dekhibā*, but *dēkh* + *ib* > *dēkhib* ; *dēkh* + *əten* > *dekhəten* but *dēkh* + *eũ* > *dēkheũ*.

Note.—When once the shortening of a vowel has taken place according to this rule it remains in spite of the conditions being disturbed on account of a later elision of a vowel, e.g. *mān* + *ətiũ* > *manətiũ* ; in spite of the elision of *ə* the first vowel remains short in *mantiũ*.

§ 8. Some postpositions have two forms[1]—short and long. The long form is used after

(1) monosyllables containing
    (*a*) a final long vowel, e.g. *jī sē*, *tī sē* ;
    (*b*) a short vowel whether followed or not by one consonant, e.g. *da kā acchar*^{a}, *ghar sē* ;
(2) dissyllables containing two short syllables and a final short vowel, e.g. *kehi sē*

The short form is used after

(1) monosyllables containing
    (*a*) a long vowel followed by a consonant, e.g. *cōrs*^{e} ;
    (*b*) a short vowel followed by two consonants, e.g. *mard s*^{e} ;
(2) dissyllables containing
    (*a*) two short syllables of which one ends in a consonant, e.g. *phanṭi kə*, *ahir s*^{e} ;
    (*b*) one or more long syllables, e.g. *hiā̃ s*^{e} > *hiā̃s*^{e}, *āgi kə* ;
(3) all polysyllables, e.g. *bhaṅgini s*^{e}, *kahāran s*^{e}, *nauniya s*^{e}.

Note 1.—If the last vowel of a word preceding a short postposition is long it is pronounced short, e.g. *ghōṛā* + *s*^{e} > *ghōṛa s*^{e} : *nānī* + *s*^{e} > *nāni s*^{e}

Note 2.—If the word after which a long postposition is used, is lengthened, by adding a termination or otherwise, the long postposition can no longer be used after it, e.g. *ghar sē* but *gharahe s*^{e}, *ī kā* but *ī ma kə*.

§ 9. The following sandhis have been observed :—

(1) if *i* or *u* comes between two vowels of the same

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[1] *Vide* Chap. VI § 91 and Chap. VII §§ 135–138.

quality it becomes *y* or *w* respectively, e.g. *lai* + *āō* = *layāō*, *gāũ* + *ai* = *gāwai*;

(2) it a short vowel occurs at the end of a word and stands between two consonants having the same place of articulation it disappears, e.g. *bhāji* + *jāu* = *bhāj jāu*, *bhāgi* + *gawā* = *bhāggawā*, *sāni* + *dēu* = *sāndēu*, *cali* + *dihā* = *caldihā*, *mili* + *jātⁱ* = *mil jātⁱ* but *mili gā*;

(3) a breathed consonant at the end of a word is assimilated with a voiced consonant of the same class, coming after it, e.g. *sāt* + *dāī* = *sāddāī*;

(4) a nasalisation + a breathed consonant becomes a full nasal before a consonant having the same place of articulation, e.g. *pahũci jāu* = *pahũc jāu* = *pahuñjāu*, *pā̃c* + *chā* = *pāñchā*;

(5) *h* coming between two vowels of which the first is short and is preceded by an unaspirated breathed or voiced stop, has a tendency to be combined with that consonant so that an aspirated consonant results, e.g *kab* + *ahũ* = *kabhaũ*, *jātⁱ* + *hai* = *jāthyai*, *paca* + *hattari* = *pachattari*, *kⁱ* + *hiā̃* = *khiā̃* but *kehi*, *mahi*;

(6) *r* or *r* + a short vowel at the end of a word is assimilated with a following *ḍ* or *l*, e g. *cōr* + *ḍārigā* = *cōḍḍārigā*, *cōr* + *lihisⁱ* = *cōllihisⁱ*, *māri* + *ḍaribā* = *māḍḍaribā*, *nikāri* + *lēu* = *nikāllēu*.

§ 10. Stress accent seems to play no part in this language.

§ 11. Words very frequently used have a tendency to shorten their last syllable, e.g. *jō* > *jo*, *tau* > *ta*, *ki* > *kⁱ*, *kā* > *ka*.

LIMITS OF THE DIALECT.[1]

§ 12. The boundaries of Dt Kheri are :—

North—Nepal Terai, east—Dt. Bahraich. south—Dts. Sitapur and Hardoi, west—Dt Shahjahanpur and north-west—Dt. Pilibhit.

The dialect is surrounded by Nēpālī on the north, by Awadhī of Bahraich on the east and by Kanaujī on the west and south-west.

§ 13. The following are the chief points[2] of difference between the dialects of Lakhimpur and Bahraich :—

Bahraich.	Lakhimpur.
(1) Gen. masc. sg. postpositions, *kai*, *kar*, *kə*, *kā*;	(1) *kai* and *kar* entirely absent;
(2) gen. masc. obl. *kē* almost a general obl. post-	(2) this use of *kē* is not found at all;

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[1] My information on this point is mostly based on L.S.I. VI and IX.

[2] *Vide* L.S.I., VI, pp. 44–45 and 49–54.

Bahraich.	Lakhimpur.
position, e.g. *wahi kē*—to him (due to influence of Bhōjpurī);	
(3) imperf part. in —*at* ;	(3) corresponding participle in *at*[i] ;
(4) *kēū* (some one) ;	(4) *kōī* (some one);
(5) final —*h* in verbal forms, e.g. *āwah*, *diheh*.	(5) corresponding —*u* in verbal forms, e.g. *āwau*, *diheu*.

The dialect of Sitapur[1] is practically the same as that of Lakhimpur.

§ 14. Forms of Kanaujī begin to be found at Gōlā Gōkaran Nāth which is in Kheri District and at a distance of only twenty-five miles from Lakhimpur. The chief points of difference between Kanaujī[2] and Lakhimpur Awadhī are :—

Kanaujī.	Lakhimpur Awadhī.
(1) Nom. postposition *nē*.	(1) Nom. postposition absent.
(2) Past Ind. of *hōb*—*hatō*, *thō*.	(2) *hatō* and *thō* forms absent, the only forms are *rahai*, etc.
(3) Fut. Ind. *-haũ* or *-gō* forms for all persons.	(3) *-haũ* forms for all except 1st pl. which has *-b* forms, e.g. *karibā*, *karib* ; *-gō* forms absent.
(4) Noun, adj., perf. part. or verb ends in *-ō*, e.g. *ghōṛō*, *acchō*, *āwō*, *gawō*.	(4) The same noun, adj., perf. part. or verb ends in *-ā*, e.g. *ghōṛā*, *acchā*, *āwā*, *gawā*.

§ 15. Kheri is one of those districts where Awadhī and Kanaujī meet. Therefore the Kanaujī of Shahjahanpur[3] shares some peculiarities with Lakhimpur Awadhī (e.g. *kā* acc.-dat. postposition) and the Lakhimpur dialect with the Shahjahanpur dialect (e.g. *mahiyā̃* —an alternative locative postposition).

COMPARISON WITH THE LANGUAGE OF THE RĀMĀYAṆA.

§ 16. The language of the Rāmāyaṇa of Tulsīdās which broadly represents forms of the Awadhī of the 16th century resembles generally the dialect of Lakhimpur. The chief points of resemblance are :—

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[1] The specimen given on L.S.I. VI, p. 91 does not represent the dialect of Sitapur town but that of the western portion of the district. In the town *rahaī*, *sẽ*, *chōṭ*, are used for the forms *hatẽ*, *tẽ* and *chwāṭ* respectively.

[2] L.S.I. IX, Part I, p. 85.

[3] L.S.I. IX, Part I, pp. 398–400.

Rāmāyaṇa.	Lakimpur.
(1) Noun sg. obl. ends in -ē.	(1) Noun sg. obl. generally lost but remnants found specially in loc., e.g. *sapnē, māthē, kā̃dhē, janē.*
(2) Noun pl. obl. in -*ana* or -*anha*.	(2) in -*an*.
(3) Adj. obl. masc. in -ē	(3) in -ē.
(4) Pronouns generally agree.	(4) Except that obl. of 1st and 2nd person pronouns no longer exists.
(a) Gen. *mōr, mōri, mōrē, tōr, tōri, tōrē* found with others *mērō, tērō*, etc.	(a) only *mōr, mōri* > *mōr*^{i}, *mōrē, tōr, tōri* > *tōr*^{i}, *tōrē* found, others absent.
(5) 1st pl Imperative ends generally in -*iya*, e.g. *āiya, kahiya, bēdhiya*.	(5) in -ī, e.g. *āī, kahī, bēdhī*.
(6) Past Indic. trans. verb agrees generally with the object in num. and pers., e.g. *jananī bālaka anhawāyē*.	(6) always agrees with the subject, e.g. *jananī bālakan kə anhawāis*^{i}.
(7) Past Indic. 2nd sg. sometimes ends in -*esi*, e.g. *sunāyesi*.	(7) ends always in -*is*^{i}, e.g. *sunāyis*^{i}.
(8) Past Indic intrans in -*ā*, *ī* and -*ē*.	(8) similarly.
(9) Past Conj. in -*eũ*, *ehu*, etc., e.g. *hōteũ, milatehu*.	(9) in -*iũ*, *iu*, e.g. *hōtiũ, milətiu*.
(10) Fut Indic. generally in -*b* forms for all persons; -*h* forms sometimes in 1st sg, 2nd pl. and 3rd pl., e.g. *chā̃ḍihaũ, byāhihau, sunihahī̃*.	(10) -*b* form only in 1st pl. and -*h* forms for the rest. e.g. *chā̃ṛihaũ, bihaihau, sunihaī̃*.
(11) Inf. dir. in -*ab*; obl in -*ana* (*karana*; *hā̃sana*).	(11) dir. in -*ab*; obl in -*ai* (*karai, hā̃sai*).
(12) Sometimes dative postposition *badi* found (*bipra badi*)	(12) *badi* one of the regular dative postpositions.

CHAPTER II.

NOUNS.

Gender.

§ 17. Nouns have two genders : masculine and feminine, e.g. *bāmhan, diyā, dhōbī, gā̃u, nāū* and *bajār, ḍebiyā, ārati, naddī*.

§ 18. Some nouns form the fem. regularly by adding terminations to the masc.

Nouns ending in consonants add either *-ī* (e.g. *suar* : *sōrī* < *suarī, bhatīj* : *bhatījī*) ; *-in* (e g. *camār* : *camārin*,) or *-āin* (e.g. *paṇḍit* : *paṇḍitāin, ṭhākur* : *ṭhakurāin*). Those ending in *-ā* either substitute *-ī* for *-ā* (e.g. *bakrā* : *bakrī*), *-in* for *-ā* (e g. *baniā* : *banin*) or *-inī* for *-ā* (e.g *laṛikā* : *laṛikinī*) or add *-in* to *-ā* (e.g *lālā* : *lalāin*).[1]

Those ending in *ī* substitute *-in* for *-ī* (e.g. *mālī* : *mālin*). Those ending in *-ū* either add *-āin* (e.g *gurū* : *guruāin*) or substitute *-uni* for *-ū* (e.g. *nāū* : *nāuni*).

Case.

§ 19. There are two cases : direct and oblique, e g. *ghar* : *gharan, kuttā* · *kuttan*.

§ 20. The dir. is used in the singular to denote the subject (e g. *kuttā mari gā*—the dog died), the vocative (e.g. *ghōsī*—O milkman) or the inanimate direct object (e.g. *lahāsi phū̃ki dēu*—burn the corpse). In the above cases it is used without any postposition, but to denote all other cases of the singular it is employed with the various postpositions (enumerated in Chap. vii §§ 134–140).

In the plural the dir is used either as a subject (e.g. *sab kuttā marí gē*—all dogs died) or as an inanimate direct object e.g. (*sab birwā kāṭi ḍārau*—cut all the trees down).

In a few expressions the dir. is found used as an instrumental (e.g. *jabardastī uthāi lai gē*—took away by force , a genitive (e.g. *tanikai bāt khātir*—for the sake of a little) or a locative (e.g *kaljug mə ghar ghar laṛāī hōī*—in the Iron Age there will be quarrels in every home).

§ 21. The oblique is used only for the plural and so, in other words, there is only one case as far as the singular is concerned.[2] It is employed as a subject optionally in cases where a transitive verb is in the past based on the ancient perfect participle (e.g. *bamhanan* or *bāmhan sab kām bigārⁱ dihin'*—the Brahmans spoiled everything). Except when used as above, the obl. has always a postposition with it.

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[1] *Vide* Chap. I § 7 for vowel-shortening in the first syllable.

[2] But see § 4 note.

Like the dir. in the singular, the obl. in the plural is in a few expressions used as an instrumental, e.g. *tum hamkā lāṭhin māreu*—you struck me with sticks.

§ 22. The obl. is formed from the dir. by adding

(*a*) *-an* if the noun ends in a consonant or *u*, e.g *cōr : cōran*, *gā̃u : gā̃wan ;*

(*b*) *-n* if the noun ends in other vowels (shortening a vowel, if it is long, before the termination), e.g. *tarwāri : tarwārin*, *diyā : diyan*, *ghōsī : ghōsin*, *Hindū : Hindun*.

Other Cases.

§ 23. There is a special case for the vocative plural. It is formed by adding *-au* to a noun ending in a consonant (e.g. *kahārau rē*) or *-u* to a noun ending in a vowel (shortening it if it is long). e.g. *meharuau rī*. This case is, however, rarely employed. The enclitics *rē* (masc.) and *rī* (fem.) are often added after the full forms.

§ 24 Nom. and acc. pl. in *ai* occurs in some words, e.g. *barsai* (years), *kitābai* (books), *bajārai* (markets).

§ 25. An instrumental ending in *-en* is found in such adverbial expressions as *piyāsen*. *bhūkhen*, *ḍaren* (out of thirst, hunger or fear) alone, e.g. *ham piyāsen marē jāit' hai*—we are dying out of thirst ; or followed by *mārē*, e.g *wui ḍaren mārē bhāg gayē*—he fled away out of fear.

§ 26. A case expressing motion towards and ending in *-ai* is found in such usages as *bajārai gayē*—went to the market. Similarly *gharai*, *madarsai*, *gā̃wai*.

§ 27. A locative ending in *-ē* is found in *duārē* (outside, on the door), *samahē* (before, in front). These are used without the postposition. *Ghāmē*, *kāmē*, *caumāsē*, *sapnē* and others are generally employed with the postposition.

Form.

§ 28. Many nouns have two forms : one short and the other long, e.g. *naddī : nadiyā*, *ghōṛā : ghoṛawā*, *nāū : nauwā*, *nāuni : nauniyā*, *kahār : kaharwā*. Some nouns have only what seems to be the long form. e.g. *bilaiyā* : cf. Hin. *billī*, *ḍebiyā* : cf. Hin. *ḍibbī*. They have lost the short form.

The short form is more generally used. The long one is used only familiarly and is never used of superiors. It is also used in calling the younger, e g. *babuā*, *nauwā rē*.

Emphatic [1] *Forms.*

§ 29. To denote the sense of *also* (inclusive) *-au* is added to a noun dir. or obl. if it ends in a consonant or in *-u-* and

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[1] **Emphatic terminations are added to pronouns (Chap. V § 63), adjectives (Chap. III, § 41) participles and adverbs (Chap. VII § 133) as well.**

-u if it ends in any other vowel (shortening it if it is long), e.g. *kitābau bəhi gai*—the book also was lost, *gā̃wau jari gā*—the village also was burnt; *mardan kə tau māḍḍāreu ab kā meharuanau kə marihau*—you have already murdered the men, now do you propose to kill the women also?

To denote the sense of definiteness or of emphasis *-ai* is added to a noun in a consonant or in *-u* and *-i* to a noun ending in a vowel (shortening it if it is long), e.g. *kumhārai giri gā*—the potter *himself* fell down. *kuttai bhāgi gā*—*the* dog fled away.

Note 1.—These terminations may be added to the nouns or pronouns or instead of them to the postposition following them if it is long and not short, e.g. *-au* added to *ghar sē* becomes either *gharau s*^{e} or *ghar seu.*

Note 2.— *-ahū* (instead of *-au* or *-u*—inclusive) and *-ahē* (instead of *-ai* or *-i* -definitive) may be optionally added to nouns consisting of one syllable or of two short syllables. If a dissyllabic or a long mono-syllabic word ends in a consonant *-ahū* and *-ahē* cannot be added, e.g. *gharahū, gharahē*; but *cōrau, cōrai.*

Periphrastic Plurals.

§ 30. The words *lōg* and *panc* are added to substantives to form the periphrastic plurals. The first denotes a class and the second a class or collection of things of the same type. To form the obl. the termination *-an* is then added to these words and not to the noun which they follow, e.g. *kurmī lōg bartan nā̃ī mā̃jat*^{i} *haĩ*—the kurmīs—the kurmi class—do not clean utensils; *kahār logan mə pañcāit k*^{i} *rīti hai*—the Pancāit system prevails amongst the kahārs; *ham pañc cōrī nā̃ī kai sakit*^{i} *hai*—people of our sort cannot steal: *ham pañcan mə purda kə calan hai*—the purdah system prevails amongst our people.

Note.—*pañc*, however, is used generally only with 1st and 2nd pers. pronouns (*ham* and *tum*).

CHAPTER III.

ADJECTIVES.

Gender.

§ 31. Adjectives as a rule have two genders: masculine and feminine, e.g. *nīk* : *nīk*^{i} (good).

§ 32. The fem. is formed by

(*a*) adding -^{i} to the māsc. if it ends in a consonant, e.g. *pātar*: *pātar*^{i} (thin), *gīl* : *gīl*^{i} (wet), *ṭhaṇḍh* : *ṭhaṇḍh*^{i} (cold);

(*b*) changing *-ā* into *-ī* if the masc. ends in *-ā*, e.g *baṛā* : *baṛī* (big), *thōrā* : *thōrī* (little);

(*c*) adding -*ī* (after shortening *ū* to -*u*) if the masc. ends in *ū*, e.g. *karū* : *karuī* (bitter).

Note.—Adjectives ending in -*ū* change only optionally for the fem., e.g. *garū* or *garuī bāltị* (a heavy bucket).

§ 33. The following adjectives do not change for gender: *lāyak* (able), *sapēt* (white), *kharāb* (bad), *ujār* (desolate), *lāl* (red), *kariā̃* (black), *bā̃di*[1] (useless), *bhārī* (huge), *jaṛāū* (inlaid).

Case

§ 34. Adjectives have two cases: dir. and obl., e.g. *ṭhanḍh* : *ṭhanḍhē*, *gīl^i* : *gīlī*.

§ 35. Attributively the dir. is used to qualify a sg. noun when there is no postposition with it (e.g. *ham ēk kuā̃r laṛikā dēkhen*—I saw an unmarried boy; *kuā̃r^i laũṛiā̃*—unmarried girl) or to qualify a pl. noun optionally if it is in the masc. gender and is used without a postposition provided that the adjective ends in a consonant, e.g. *kuā̃r* (or *kuā̃rē*) *laṛikā jāti haĩ*—unmarried boys are going, but *bhalē laṛikā jāt^i haĩ*.

Predicatively the dir. is used with a sg. noun always, e.g. *wahu laṛikā* (or *wā laũṛiā̃*), *kuā̃r* (or *kuā̃r^i*) *hai*—that boy (or girl) is unmarried, and only optionally with a pl. noun of masc. gender provided that either (*a*) the adjective ends in a consonant (e.g. *wui laṛikā kuā̃r*—or *kuā̃rē*—*haĩ*—those boys are unmarried. *wui laṛikan kə kuā̃r*—or *kuā̃rē*—*batāwat^i haĩ*—they say those boys are unmarried) or (*b*) if it ends in a vowel the noun with which it agrees is used with a postposition (e.g. *wui laṛikan kə bhalā*—or *bhalē*—*batāwat^i haĩ*—they say those boys are good).

§ 36. Attributively the obl. is used to qualify a sg. noun followed by a postposition (e.g *wui kuā̃rē laṛika kə*—or *kuā̃rī laũṛia kə*—*sab janē dēkhin^i*—everybody saw that unmarried boy—or girl) or to qualify a pl. noun, e.g. *wui kuā̃rē* (or *kuā̃r*[2]) *laṛikā huā̃ haĩ*—those unmarried boys are there; *wui kuā̃rī laũṛiā hiā̃ haĩ*—those unmarried girls are here.

Predicatively the obl. is used always with a pl. noun. e.g. *wui laṛikā kuā̃rē* (or *kuā̃r*[2]) *haĩ*.

Note.—If a sg. noun is used as a subject of a pl. verb, the adjective which qualifies that noun must be plural, e.g. *barēlīwālē cācā āyē haĩ*; *Rāmcandra baṛē acchē rājā rahaĩ*: *ī thānēdār baṛē haĩ wui chōṭ haĩ*.

Form.

§ 37. The masc. obl. is formed from the masc. dir. (*a*) by adding -*ē* if the dir. ends in a consonant or in -*ū* (shortening -*ū* to -*u*), e.g. *dūbar* : *dubarē*, *karū* : *karuē*; (*b*) by substituting -*ē* for -*ā* if the dir. ends in -*ā*, e.g. *bhalā : bhalē*. If the dir. itself ends in -*ē* no change is made, e.g. *kettē*.

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[1] *bādi* is used only predicatively.

[2] For the optional use of the direct see above § 35.

The fem. obl. is formed from the fem. dir. by lengthening ^{i} to *ī*, e.g. *gīl^i : gīlī*. If the dir. itself ends in -*ī* no change is made, e.g. *bhalī : bhalī*.

Note.—Fem. dir. is never used with a plural noun.

§ 38. Adjectives which do not change for gender do not change for number and case either, and those which change optionally for gender change optionally for number and case also, e.g. *sapēt* : *sapēt*, *karū* : *karū* or *karuē*.

§ 39. If an adjective is used as a noun, its obl form (or the dir. itself if there is no obl.) serves as the sg. obl., e g. *acche kə rākhi lēu*—retain the good (boy), but it forms the pl. obl by adding terminations like ordinary nouns[1] to its obl. form or to the dir. if there is no obl., e g. *hiā̃ kharūb au acchē dūnau tana k^e admī haī̃*—here are boys of both sorts, good and bad, *acchā acchen kə rākh^i lēu kharāban kə bahirī nikāri dēu*—all right, retain the good but turn the bad out.

Degrees of Comparison

§ 40. There are no separate forms for the comparative or the superlative. The sense of the comparative is expressed either by using some such word as *jādā*, *bahut* (more), *kam* (less), e.g. *yū laṛikā wui sē jādā gōr hai*—this boy is fairer than that, *wū laṛikā ī sē kam gōr hai*—that boy is less fair than this; or better by using the simple adjective with the ablative postposition *sē* or *s^e* following the noun with which the comparison is made, e.g. *yū laṛikā wui sē gōr hai*—this boy is fairer than that; *wū laṛikā ī sē kariā hai*—that boy is darker than this.

The sense of the superlative is expressed by a simple adjective preceded by *sab mā* (amongst all) with or without some noun like *admī*, e.g. *yū laṛikā sab mā nīk hai*—this boy is best of all, *yū admī sab admin mə nīk hai*—this man is best of all men.

§ 41. The emphatic forms of adjectives are made according to the rules given in Chap II § 29, e.g. *yū ṭabkā mīṭhau hai khaṭṭau hai*—this mango is both sweet and sour, *paũṛā mīṭhai hai khaṭṭā nāī*—the sugar-cane is sweet only, not sour.

CHAPTER IV

NUMERALS.

Cardinals.

§ 42. The following are the cardinal numerals:—

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[1] *Vide* Chap. II; 22.

1	*ēk.*
2	*dui.*
3	*tīni.*
4	*cāri.*
5	*pā̃c.*
6	*chā.*
7	*sāt.*
8	*āṭh.*
9	*nau.*
10	*das.*
11	*gērā.*
12	*bārā.*
13	*tērā.*
14	*caudā.*
15	*pandarah.*
16	*sōrā.*
17	*sattarā.*
18	*aṭhārā.*
19	*onais.*
20	*bīs*
21	*ekais.*
22	*bāis.*
23	*tēis.*
24	*caubis.*
25	*pacīs*
26	*chabbis.*
27	*sattāis.*
28	*aṭṭhāis.*
29	*ontis.*
30	*tīs.*
31	*ekətis.*
32	*battis.*
33	*tē̃tis.*
34	*caũtis.*
35	*paĩtis.*
36	*chattis.*
37	*saĩtis.*
38	*aṛətis.*
39	*ontālis*
40	*cālis.*
41	*ekətālis.*
42	*bayālis.*
43	*tē̃tālis.*
44	*cauwālis.*
45	*paĩtālis.*
46	*chiyālis.*
47	*saĩtālis*
48	*aṛətālis.*
49	*oñcās.*
50	*pacās.*
51	*ekkyāwan.*
52	*bāwan.*
53	*tirpan.*
54	*cauwan.*
55	*pachpan.*
56	*chappan.*
57	*sattāwan.*
58	*aṭṭhāwan.*
59	*onsaṭhi.*
60	*sāṭhi*
61	*ekəsathi.*
62	*bāsaṭhi.*
63	*tirsathi.*
64	*caũsathi.*
65	*paĩsathi.*
66	*chā̃chaṭhi.*
67	*sarsaṭhi.*
68	*aṛəsaṭhi.*
69	*onhattari.*
70	*sattari.*
71	*ekhattari.*
72	*bahattari.*
73	*tihattari.*
74	*cauhattari.*
75	*pachattari.*
76	*chiyattari.*
77	*sathattari.*
78	*aṭhattari.*
79	*onnāsī.*
80	*assī.*
81	*ekkyāsī.*
82	*bayāsī.*
83	*tirāsī.*
84	*caurāsī.*
85	*pacāsī.*
86	*chiyāsī.*
87	*sattāsī.*
88	*aṭṭhāsī.*
89	*nawāsī.*
90	*nabbē.*
91	*ekkyanbē.*
92	*bānbē.*
93	*tirānbē.*
94	*caurānbē.*
95	*pañcānbe.*
96	*chānbē.*
97	*sattānbē.*
98	*aṭṭhānbē.*
99	*ninnānbē.*
100	*sau.*
1.000	*hajār.*
1,00,000	*lākh.*

Ordinals.

§ 43. These have two genders, masc. and fem. The following are irregular :—

1st *pahil* 2nd *dōsar* 3rd *tīsar.*
4th *cauth* 6th *chaṭṭhā.*

The above five form their fem. like adjectives. (Chap. III § 32).

Other ordinals are formed by adding *awā̃* (masc.) or *aī̃* (fem), e g. *pā̃c* : *pā̃cawā̃* : *pā̃caī̃*, *bā̃is* : *baisawā̃* : *baisaī̃*.

Note.—11th to 18th, however, insert a short *h* in the termination, e.g. *gērā* : *gerahwā̃* : *gerahī̃*.

Multiplicative Numerals.

§ 44. There are no special numerals of the type of twice, thrice, etc. The sense is, however, given by some word expressive of time usually *dāĩ* or *dāũ*. Twice is thus resolved to 'two times' *dui dāĩ*, thrice to 'three times' *tīni dāĩ*. For instance *ham sab janē din bhare mə ēkai dui dāĩ khā^{i}t^{i} hai, sāheb, lōg tau pā̃c pā̃c chacchā dāũ ṭipan uṛāwat^{i} haĩ* —we eat food only once or twice a day while the sahebs eat tiffin five or six times.

The following words are used only for the multiplication tables:—

Ekkan (once), *dūnī* (twice), *tiyā̃* (thrice), *cakkū* (four times), *pañcē* (five times), *chakā̃* (six times), *satē* (seven times), *aṭṭhē* (eight times), *nawā̃* (nine times), *dasāwan* (ten times).

The following are the most common fractional numerals:—

¼	*pauwā*	¾	*paunu*	1½	*ḍēṛh*
½	*ādhā* or *addhā*	1¼	*sawāu*	2½	*aṛhāĩ*

Definite and Indefinite.

§ 45. To add the sense of definiteness to a number *-au* is added to it if it ends in a consonant or in *-u* and *-u* if it ends in some other vowel, e.g. *duiu*—both, *cāriu*—all the four, *nawau*—all the nine.

To express the sense of indefiniteness *-an* (if a number ends in a consonant or in *u*) or *-n* (if it ends in any other vowel) is added to it, e.g. *bīsan*—scores, *pacā̃san*—fifties, *hajāran*—thousands.

CHAPTER V.

PRONOUNS.

§ 46. A pronoun is always followed by a postposition except when used as a subject or as an inanimate direct object. The oblique, wherever it exists separately, is used with a postposition.

§ 47. Pronouns which have separate genitive forms are never followed by genitive postpositions. The genitive form has oblique and feminine forms like ordinary adjectives, e g. *mōr ghōṛā*—my horse, *mōrē ghōṛa kə*—to my horse, *mōr^{i} ghoṛiā*—my mare, *mōrī ghoṛia kə*—to my mare.

§ 48. If a pronoun has separate forms for singular and plural, the plural is generally used for the singular person also, e.g I said—*ham kahen* (*mai kaheũ* less frequently).

Sg. 2nd pers. (*tui*) is used only for the younger, chiefly children and the servants. It expresses either deep affection or contempt. A father for his grown up son or daughter will always use the pronoun *tum*—you.

Personal Pronouns.

§ 49. 1st pers.

sg.	pl.
mai, mahi	*ham.*

Gen. *mōr*—masc. dir. (my); *hamār*—masc. dir. (our), e.g. *mai gayeũ*—I went, *ham gayen*—we went; *mai kā dēu*—give me, *ham kā dēu*—give us: *mōr*^{i} *kitāb*—my book, *hamarē larika kə*—to our son.

§ 50. 2nd pers.

sg.	pl.
tui, tuhi.	*tum.*

Gen. *tōr*—masc. dir. (thy); *tumhār*—masc. dir. (your), e.g. *tui gawā* or *tum gayeu*—you went, *tui kā* or *tum kā maribā*—I shall beat you; *tōrē* or *tumharē larikawa s*^{e}—from your son.

Note.—*mahi, tuhi* are very rarely used; in the obl. of *hamār* and *tumhār* the second syllable becomes short *hamarē*, *hamarī*, etc

§ 51. 3rd pers.

	sg.	pl.
dir. masc.	*wū, wahu*	*wui.*
fem.	*wā, wah*	
obl.	*wui, wahi*	*un, unh.*

e g. *wū* or *wahu kahis*^{i}—he said, *wā* or *wah kahis*^{i}—she said, *wui kahin*^{i}—they said: *wui kā* or *wahi kā dēkhen*—we saw him (her), *un* or *unh kā dēkhen*—we saw them.

Demonstrative Pronouns.

§ 52. The forms of the Remote Demonstrative are the same as those of the 3rd pers. pronoun. Those of the pronominal adjective *that* are also the same except that obl. pl. has three forms:—

un, unh and *wui* For instance:—

wū or *wahu larikā, wā* or *wah laũriā, wui larikā* or *laũriā, wui* or *wahi larika kə* or *laũria kə; wui, un* or *unh larikan kə; wui, un* or *unh laũrian kə.*

§ 53. *Proximate Demonstrative Pronoun.*

dir. masc.	*yū, yahu*	*ī*
fem.	*yā, yah*	
obl.	*ī, ehi*	*in, inh.*

The forms of the pronominal adjective *this* are the same as above except that obl. pl. has three forms: *in, inh* and *ī*, e.g. *ī, in* or *inh larikan kə mārau*—beat these boys, *ī, in* or *inh laũrian kə mārau*—beat these girls.

§ 54. *Relative Pronoun.*

dir.	*jō, jaun*	*jō, jaun, jī.*
obl.	*jī, jehi*	*jin, jinh.*

Correlative Pronoun.

dir.	*sō, taun*	*sō, taun, tī.*
obl.	*tī, tehi*	*tin, tinh.*

e.g. *jō* or *jaun jais karī sō* or *taun tais pāī*—as one will do so one will get.

The pronominal adjectives of these have the same forms except that *jī* and *tī* are the more usual forms than *jin, jinh* and *tin, tinh* ,in obl. pl. *jī* and *tī* also replace *jō, jaun* and *sō, taun* of dir. pl., e.g. *jī laṛikā dundu macāwat' rahaĩ tī sab bhāg gayē*—all those boys who were making noise have run away.

These pronouns also form their pronominal adjectives on *jaun* and *taun* by taking the terminations of ordinary adjectives :—

	masc.	fem.
dir.	*jaun, taun*	*jaun', taun'.*
obl.	*jaunē, taunē*	*jaunī, taunī.*

§ 55. *Interrogative Pronoun.*

	sg.	pl.
dir.	*kō, kaun*	*kaun.*
obl.	*kī, kehi*	*kin, kinh.*

e.g. *kō* or *kaun hai*—who is there ? *huā̃ kaun rahaĩ*—who were there ? , *kī* or *kehi kā māreu*—whom (sg.) did you beat ? *kin* or *kinh kā māreu*—whom (pl.) did you beat ?

The pronominal adj. *kaun*—masc dir is declined like ordinary adjectives. In addition it has the alternative forms *kī, kehi* in sg. obl. and *kī* in pl obl., e.g. *kaun admī mari gā*—which man died ? *kaun' meharuā mari gai*—which woman died ? , *kaunē, kī admin kə* (or *admi kə*) *māreu*—which men (or man) did you beat ? , *kaunī, kī meharuan kə* (or *meharua kə*) *māreu*—which women (or woman) did you beat ?

The pronoun 'what' (inanimate) has separate forms *kā* dir. and *kāhē* obl., e.g. *tum kā kaheu*—what did you say ? *tum wui kā kāhe sᵉ māreu*—with what did you beat him ? The adj. based on this pronoun has, however, the forms of *kaun.*

§ 56. The adjectives of manner : *ais* (of this sort, such), *wais* (of that sort, such), *jais tais* (such as), *kais* (of what sort ?) , of quantity *ettā* or *attā* (so much), *ottā* (that much), *jettā-tettā* (as much-as), *kettā* (how much ?) and of number : *ettē* or *attē* (so many), *ottē* (so many) *jettē-tettē* (as many-as) and *kettē* (how many ?) , are all treated like ordinary adjectives and have their obl., and fem. forms accordingly, e.g. *aisē din mā ghar baiṭhau*—sit at home on such a day, *wais' kitāb* *phiri nāĩ milī*—never will a book of that sort be found, *ettē āṭa* s^e *hamār*^{i} *bhūkh nāĩ jāī*—my hunger will not be satisfied with so much flour, *ham ottī rōṭī khāyen*—I took that much bread, *tum kettā kām kiheu*—how much work did you do?; *tumharē kettē laṛikā au kettī laũṛiā haĩ*—how many sons and daughters have you got?, *jettē laṛikā tumharē haĩ tettē hamarē*—I have as many sons as you have, *jettī laũṛiā hamarē haĩ tettī kōi k*^{e} *nāĩ*—no one has so many daughters as I have.

Indefinite Pronouns.

Aur.

§ 57. This pronoun expresses the sense of 'more,' 'other' (else) and is indeclinable, e.g. *aur kā cahī*—what more is required?, *aur kaun sahar jāī*—who else will go to the city, *thōrē admī hiā̃ haĩ aur huā̃ baiṭh haĩ*—some men are here, others are seated there

Aur as an adjective takes the ordinary terminations for forming the oblique and the feminine: *aur*, *aurē*, *aur*^{i}, *aurī*.

§ 58. *Koī*

means 'some one' or 'any one' and is indeclinable, e.g. *kōī rahai*—there was some one, *kōī nāĩ rahai*—there was nobody, *kōī rahaĩ*—there were some people, *kōi kə mārau nā*—do not beat anybody

Kōī does not change even as an adjective, e.g. *kōī admī* or *meharuā*—some man or woman, *kōī admī nāĩ āyē*—no man came, *kōī laṛika kə na mārau*—do not beat any boy.

Like *kā*, *kuchu* refers to an inanimate thing. It means something or anything; *kuchu*—dir., *kāheu*—obl., e.g. *ham kuchu nāĩ kihen*—I did nothing, *ham kāheu* s^e *pēṭ bhari lihen*—I filled my belly with something.

The adjective based on *kuchu* has the same form as *kōī*.

§ 59. The pronoun *sab* (all) has one constant form for both genders and cases, e.g. *sab kihin*^{i}—all did; *sab sē*. *sab* (all or whole) as an adjective also does not change, e.g. *sab admin* s^e *ham sē kōī matlab nāĩ*—I have nothing to do with all men, *sab duniyā matlabī hai*—the whole world is selfish.

Compound Pronouns.

§ 60. *jō kōī* (whoever) and *jō kuchu* (whatever) are the only compound pronouns and are used only in the direct, e.g. *jō kōī māris*^{i} *hōi so bakuri dēi*—whoever may have beaten, admit, *jō kuchu bhawā so bhawā*—whatever happened, happened. The oblique has the ordinary *jī*, *jehi* with or without the word *cahai*, e.g. *cahai jī kī rōṭī hōi ham khāib jarūr*—whomsoever the bread may belong to, I shall eat it.

§ 61. *apnā.*

Genitive—*apan*—masc. dir.

This pronoun is used to express (*a*) emphasis; (*b*) reflexive sense; or (*c*) the 1st and 2nd persons together.

(*a*) It may be combined with any noun or pronoun to express emphasis, e.g. *Rām apnā ban kā calē gayē, Dasarath kə rōwai kə ghar chā̃ṛi gayē*—Ram himself went away to the jungle but left Dasarath at home to weep; *tum apnā calē gayeu*—you yourself went away; *ham apnā rupayā corāyen au tum kā cōrī lagāyen*—I myself stole the money and attributed the theft to you.

(*b*) Reflexive sense is expressed in such expressions as *wui pachitāyē au apna kə bahut bhalā burā kahin*^{i}—he expressed his regret and rebuked himself very much; *tum apna kə apnē āpu māri liheu*—you hit yourself, *ham apna kə dukhu sahat*^{i} *rahen tum sē kuchu nāī kahen*—I went on putting up with troubles but never said anything to you.

(*c*) This pronoun expresses the speaker and the person spoken to together, when used absolutely, e.g. *apna s*^{e} *kaun matlab*—what have we (you and I) to do with it.

The genitive which is declined like ordinary adjectives denotes the sense of 'own' when used with a noun or pronoun and of 'our' (yours and mine) when used absolutely, e.g. *Gopāl apan*^{i} *gaiyā bẽci ḍāris*^{i}—Gopāl sold away his (own) cow; *tum apan birwā kāṭau hamār kāhē kāṭat*^{i} *hau*—cut your own tree, why do you cut mine; *apan bakərā kahā̃ gawā*—where is our goat gone?

§ 62. There are no honorific pronouns like Hin. *āp* or Bih. *rauwā̃*. When honour or respect is to be shown to any person, special care is taken to use the plural pronoun and verb. There is also a tendency not to utter the names of one's elders. Women always refer to them by some general name or indefinite expression, they never utter their names, specially that of the husband—it is a sin in their eyes.

Emphatic Forms.

§ 63. Some pronouns form the emphatics irregularly as shown below:—

	inclusive.	definitive.
mai, mahi	*mahū*	*mahē*
ham	*hamahū*	*hamahē*
tui	*tohū*	*tohē*
tum	*tumahū*	*tumahē*
wū, wahu, wā, wah	*wahau*	*wahai*
wui	*wahū*	*wahē*
un or *unh*	*unahū*	*unahē*
yū, yahu, yā, yah	*yahau*	*yahai*

	inclusive	definitive
ī	*yahū*	*yahē*
in or *inh*	*inahū*	*inahē*
jī, jehi	—	*jehē*
tī, tehi	—	*tehē*

Other pronouns make their emphatic forms with the ordinary terminations (Chap. II § 29), e.g. *sabai, kōiu.*

CHAPTER VI.

VERBS.

§ 64. The plural form of the verb is used generally even with a singular noun, specially when respect is intended to be shown, e.g. *Rām ban kā gayē*—Ram went to the jungle; *cācā bajārai gayē haĩ*—my uncle has gone to the market. There are no special honorific moods or tenses.

Root.

§ 65. The root form, for the purposes of this grammar, can be obtained from the dir. infinitive by cutting off—*wab*, —*ab* or—*b* as the case may be. e.g. *bajāwab* : *bajā—*, *dēkhab* : *dēkh—*, *hōb* : *hō—*. Most of the roots end in consonants, but a fairly large number of them end in—*ā*. Those which end in other vowels are very few.

Imperfect and Perfect Participles.

§ 66. The imperf. part. has three distinct forms: (*a*) in —*at*^{i}, e.g. *paṛhat*^{i}—reading, *dēkhat*^{i}—seeing; (*b*) in—*it*^{i}, e.g. *paṛhit*^{i}, *dēkhit*^{i}; (*c*) in—*ətī*, e.g. *paṛhətī*, *dekhətī*.

(*a*) in—*at*^{i} is used for the singular of both genders and for the masculine plural, e.g. *mai dēkhat*^{i} *haũ*—I see, *wui dēkhat*^{i} *haĩ*.

(*b*) in—*it*^{i} is used for the 1st pl. of both genders, e.g. *ham dēkhit*^{i} *han*—we (masc. or fem.) see.

(*c*) in—*ətī* is used for the fem. pl., e.g. *ī meharuā dekhətī haĩ*—these women see; *ham dekhətī* (or *dēkhit*^{i}) *han*—we (fem.) see.

§ 67. The perf. part. has four forms: (*a*) in—*ē*, e.g. *paṛhē* (read), *dēkhē* (seen); (*b*) in—*is*^{i}, e.g. *paṛhis*^{i}, *dēkhis*^{i}; (*c*) in—*in*^{i}, e.g. *paṛhin*^{i}, *dēkhin*^{i}; (*d*) in—*en*, e.g. *paṛhen*, *dēkhen*.

(*a*) in—*ē* is used for both numbers of 1st and 2nd pers., e.g. *mai ajodhyā dēkhē haũ*—I have seen Ajodhyā, *tum dēkhē hau*—have you seen ?

(*b*) in—*is*^{i} for the 2nd and 3rd sg., e.g. *tui dahiu khāis*^{i} *hai* —thou hast eaten curds, *wū* or *wā dahiu khāis*^{i} *hai*.

(*c*) in—*in*^{i} for the 3rd pl , e.g. *wui dahiu khāin*^{i} *haĩ* and

(*d*) in—*en* is used as an alternative form for the 1st pl., e.g. *ham ajodhyā dēkhen hai* (or *dēkhē han*)—we have seen Ajodhyā.

Auxiliary Verb.

§ 68. *hōb*—to be, root *hō*—.

Present Indicative

	sg.	pl.
1st pers.	(*mai*) *haũ*	(*ham*) *han, hai.*
2nd pers.	(*tui*) *hai*	(*tum*) *hau*
3rd pers.	(*wū*) *hai*	(*wui*) *haĩ*

Past Indicative.

rahaũ	*rahan, rahai*
rahai	*rahau*
rahai	*rahaĩ*

Future Indicative.

hoihaũ	*hoibā, hōib*
hoihai	*hoihau*
hōĩ	*hoihaĩ*

Present Conjunctive

hōũ	*hōĩ, hōi*
hōi	*hōu*
hōi	*hōĩ*

Past Conjunctive.

hōtiũ	*hōten, hōit*^{i}
hōt^i	*hōtiu*
hōt^i	*hōtĩ*

The Imperative has the same forms as the Present Conj. except in 2nd sg. where it has *hō* for *hōi.*

Note.—Of the alternative forms given above for 1st pl. *hai, rahai* and *hōi* are used only with—*it*^{i} (imperf.) and—*en* (perf.) forms of the participles and not with others. They are only used in periphrastic tenses. The alternative forms *han rahan* and *hōĩ* are alone used independently.

CONJUGATION OF *dēkhab*—TO SEE, ROOT *dēkh*—

(1) *Simple Tenses*

§ 69. These are formed by adding various terminations (e.g.—*eũ*) to the root and without the help of the auxiliary. They are six in number.

§ 70. Present Indicative.

dēkhaũ	*dēkhī*
dēkhai	*dēkhau*
dēkhai	*dēkhaĩ.*

This tense is no longer used in common speech (except that of the auxiliary *hōb*) and has been replaced by the Present Imperf. Indicative, e.g. I go—*mai jātᵉ haũ*, not *mai jāũ*, but I am—*mai haũ*. It, however, still survives in songs (e.g. *sōwau ki jāgau mōrī ādhi bhawīnī,....bali jāũ*[1]—are you sleeping, revered Bhawānī, or waking, I bow to thee) as the Pres. Indic. and in stories as the Habitual Past or historic present in vivid description (e.g. *mahtārī rōju chappan parkāl kᵉ bhōjan banāwai*[2]—the mother used to prepare food of fifty-six varieties daily; *rājā kacehari sᵉ āyē dēkhaĩ kā kōi kᵉ jūtā dharē*[2]—the Rājā returned from the court and what does he see—that somebody's shoes were there.

§ 71. Past Indicative.

dēkheũ	*dēkhen*
dēkhē, dēkhisᵉ	*dēkheu*
dēkhisᵉ	*dēkhinᵉ*

This tense refers to a momentary action which happened in the past, e.g. *jab mai huā sᵉ caleũ tab tum huā nāī rahau*—you were not there when I left the place. If a continuous action in the past is meant a root indicating continuous action is combined with one expressing momentary action, e.g. *mai baiṭh raheũ*—I remained seated. The difference between this tense and the Pres. Perf. Indic. and the Past Perf. Indic. is chiefly that the effect of the last two lasts after the action while it does not last in the case of this tense. The Past Indic. may, however, be used to denote an action just completed (for which English uses Pres. Perf.), e.g. *wū manaī jī kā tum pũchatᵉ rahau, āi gawā*—the man about whom you were inquiring has arrived. Thus, here, the momentary action of 'arriving' is emphasised, not its effect. If the effect were to be emphasised, the Pres. Perf. would be used.

Used conjunctively this tense refers to a future action, e.g. *mai bajār gayeũ tau tumharī khātir ṭabkā layaihaũ*—If I go (lit. if I went) to the market, I shall bring mangoes for you

Note.—2nd pl. (*dēkheu*) of this tense is also used as a future imperative or conditional, e.g. *acchā dēkheu tum kā ais mārī ki tumhār hāṛ pãjar ṭūṭi jāī*—all right you'll see, I shall beat you so much that all your bones will be broken; *acchā ab kī jo ham hallā karī tau māreu*—beat me if I again make a noise, *bhaiyā laṛikan kə dēkheu*—brother, look after the boys.

Vide Appendix (*b*) I

[2] *Vide* Appendix (*a*).

§ 72. Future Indicative.

dekhihaũ	*dekhibā̃* or *dēkhib*
dekhihai	*dekhihau*
dēkhī	*dekhihaī̃*

This tense simply refers to a future action, e.g. *ham miṭhāī̃ khaibā̃*—we shall eat sweetmeats. As compared with this, the Fut. Imperf. Indic. refers to an action which will be in the process of being acted (*jab tum aihau tab ham paṛhat^{i} hōib*—when you come, I shall be reading, i.e you will find me reading) and the Fut. Perf. Indic. refers to an action which will have been completed (e.g. *jab tum aihau tab ham paṛhē hoibā̃*—when you come, I will have finished reading). The simple Fut. Indic., however, refers (in the case of 'continuous' roots) to an action which will begin (e g. *jab tum aihau tab ham paṛhibā̃*—when you come, I shall read, i.e. I shall begin reading after your arrival).

§ 73. Present Conjunctive.

This tense has exactly the same forms as the Pres. Indic. (§ 70 above). It is used in conditional clauses (*jō mai tum kā̃ dhōkhā̃ dēũ tau kaheu*—blame me if I deceive you) or in clauses denoting purpose (e.g. *wui aisī bā̃tai kihin^{i} ki ham huā̃ s^{e} bhā̃gi jāī̃*—he spoke in such a manner in order that I should go away from there). A clause with this tense (as also every other conjunctive tense) is also preceded by some such word as *jō* (if). *jab* (when), *ki* (that), *jī mā̃* (so that).

As compared with the Pres. Imperf. Conj. (e g. *jo mai dēkhat^{i} hōũ tau mai kā̃ māreu*—beat me if I am looking) and Pres. Perf. Conj. (e.g. *jō mai dēkhē hōũ tau mārau*—beat me if I have looked) this tense denotes only simple and indefinite conjunctive sense e.g. *jo mai dēkhaũ tau māreu*—if I look, beat me, i.e. beat me even if I begin looking whether I am in the state of looking (Pres. Imperf. Conj.) or I have finished looking (Pres. Perf. Conj.)

§ 74. Past Conjunctive.

dekhətiũ	*dekhəten* or *dēkhit^{e}*
dēkhat^{e}	*dekhətiu*
dēkhat^{i}	*dekhətī̃*

This tense is based on the ancient imperf. part. like the periphrastic tenses but has the verbal terminations added to it and does not, therefore, require the help of the auxiliary. It denotes (in a conditional or purpose clause) an action which might have taken place in the past but which never came off, e.g. *jo mai ghar sē āṭh bajē cal dētiũ tau hiā̃ ṭhīk bakhat par pahũci jātiũ*—I would have reached this place in time if I had started from home at eight; *tum ais kām kartiu ki ham kā huā s^e ṭarkai kə maukā mil jāt^i*—you should have acted in such a manner that I should have got time to escape from there. Compared with Past Imperf. Conj. (*jo wui sāit^i tum Rām s^e bātai na kart^i hōtiu tau ham ais karten*—if you had not been talking—i.e. in the process of talking—to Rām I would have done like that) and Past Perf. Conj. (e g *jō tum apnai ais kām kihē hōtiu tau kā na bant^i*—if you yourself had acted in such a way—i.e. finished acting—would all have not been well ?) this tense refers not to completion or incompletion of an action but simply infers that it did not take place in the past.

§ 75. Imperative.

This tense has the same forms as the Pres. Indic. except in 2nd sg. where it has *dēkhu* for *dēkhai*. The subject in the case of the 2nd pers. is generally understood while in other cases it is generally expressed, e.g. *karu*—do (sg.), *karau*—do (pl.), *mai karaũ*—let me do, *wū karai*—let him do The forms of this tense are distinguished from those of the Pres. Indic. and Conj., by an emphatic intonation of the voice. Similarly questions are distinguished both from the Imperative and other tenses, e g. *mai karaũ*—shall I do ?

(2) *Periphrastic Tenses.*

§ 76. These are formed by combining (*a*) the Imperf. Part. and (*b*) the Perf. Part. with the various tenses of the auxiliary. The auxiliary is, however, uttered with much less emphasis than the principal verb, e.g. in *mai jāt^i haũ*—I go, *haũ* is uttered very indistinctly so much so that it seems sometimes to be absent.

(*a*) Tenses with Imperf. Part.

§ 77. Compared with the Simple and Perfect tenses, these lay special emphasis on the continuity and incompletion of an action present, past or future. They are five as shown below.

§ 78. Present Impertect Indicative.

	sg.	pl. masc	pl. fem.
1st pers.	*dēkhat^i haũ*	*dēkhit^i hai.* *dēkhat^i han*	*dekhətī han*
2nd pers.	*dēkhat^i hai*	*dēkhat^i hau*	*dekhətī hau*
3rd pers.	*dēkhat^i hai*	*dēkhat^i haĩ*	*dekhətī haĩ*

This tense refers to an action which is taking place in the present and has displaced the Pres. Indic., e.g. *mai jāt^i haũ*—

means 'I go' and not necessarily 'I am going.' It also refers to a future action about to take place, e.g. (*huã kaun jãĩ*—who will go there ?) *mai jāt*^{i} *haũ*—I am going.

Note.—The alternative form in the 1st pl. in—*it*^{i} *hai* is much more frequently used than the forms in—*at*^{i} *han* and—*ətī han.*

§ 79. Past Imperfect Indicative.

sg.	pl. masc.	pl. fem.
dēkhat^{i} *rahaũ*	*dēkhit*^{i} *rahai*	
	dēkhat^{i} *rahan*	*dekhətī rahan*
dēkhat^{i} *rahai*	*dēkhat*^{i} *rahau*	*dekhətī rahau*
dēkhat^{i} *rahai*	*dēkhat*^{i} *rahaĩ*	*dekhətī rahaĩ*

This tense refers to an action not completed in the past, e.g. *jī sāit*^{i} *tum mai kā saṛak par mileu wui sāit*^{i} *mai bajārai jāt*^{i} *rahaũ*—when you met me on the road, I was going to the market, i.e. the action of going was not completed at that time. It sometimes refers to an action which was going to happen but which was stopped somehow, e.g. *mai wui kā mārt*^{i} *rahaũ tum rōki diheu*—I was beating him (or was about to beat him) but you prevented me from doing it.

Note.—The alternative form in the 1st pl. in—*it*^{i} *rahai* is much more frequently used than the forms in—*at*^{i} *rahan* and—*ətī rahan.*

§ 80. Future Imperfect Indicative.

sg.	pl. masc.	pl. fem.
dēkhat^{i} *hoihaũ*	*dēkhit*^{i} *hoibā*	
	dēkhat^{i} *hoibā*	*dekhətī hoibā*
dēkhat^{i} *hoihai*	*dēkhat*^{i} *hoihau*	*dekhətī hoihau*
dēkhat^{i} *hōĩ*	*dēkhat*^{i} *hoihaĩ*	*dekhətī hoihaĩ*

This tense refers to an action which will be in the state of duration at some particular future time, e.g. *jab tum aihau tab ham khāt*^{i} *hoibā*—I shall be eating when you come.

§ 81. Present Imperfect Conjunctive.

dēkhat^{i} *hōũ*	*dēkhit*^{i} *hōi*	
	dēkhat^{i} *hōĩ*	*dekhətī hōĩ*
dēkhat^{i} *hōi*	*dēkhat*^{i} *hōu*	*dekhətī hōu*
dēkhat^{i} *hoi*	*dēkhat*^{i} *hōĩ*	*dekhətī hōĩ*

This tense refers to a continuous conditional action present or future, probable or improbable, e.g. *jō tum jhūṭ bōlat*^{i} *hōu tau ham kā karī*—what shall I do if you are (or were) telling a lie, *jō ham kalhi ī sāit*^{i} *sōwat*^{i} *hōĩ tau ham kā māreu*—beat me if you find me sleeping to-morrow at this time.

§ 82. Past Imperfect Conjunctive.

sg.	masc. pl.	fem. pl.
dēkhatⁱ hōtiũ	*dēkhitⁱ hōten* *dēkhatⁱ hōten*	*dekhətī hōten*
dēkhatⁱ hōtⁱ	*dēkhatⁱ hōtiu*	*dekhətī hōtiu*
dēkhatⁱ hōtⁱ	*dēkhatⁱ hōtī*	*dekhətī hōtⁱ*

This refers to a continuous action in the past which might have happened but which did not happen, e.g. *wui sāitⁱ jō tum sē ham batlātⁱ hōten tau tum kā wā bāt jarūr batauten*—if I had been talking to you at that time, I would have told you that thing.

(*b*) Tenses with Perf. Part.

§ 83. These lay emphasis on the completion of an action, whether it be in the present, past or future, having special reference to the effect of that action at the time of speaking, or at the time referred to in the speech. They are five in number as shown below.

§ 84. Present Perfect Indicative.

sg.	pl.
dēkhē haũ	*dekhē han* or *dēkhen hai*
dēkhē hai or *dēkhisⁱ hai*	*dēkhē hau*
dēkhisⁱ hai	*dēkhinⁱ haĩ*

The difference between this tense and the Past Indic. is that this refers to an action the effect of which lasts up to the present while the Past Indic. refers to an action which has no effect at present, e.g. *mai kuā̆ mə giri gā haũ* –I have fallen into the well, i.e. I am still there while *mai kuā̆ mə giri gayeũ* refers to the momentary action of falling but does not show that I am still there.

Compared with the Past Perf. Indic. this tense refers to the recent past while the Past Perf. Indic. to the remote past, e.g. *mai gā̃wai gawā haũ*—I have gone to the village, refers to nearer past than that referred to in *mai gā̃wai gawā rahaũ*—I had gone to the village.

§ 85. Past Perfect Indicative.

dēkhē rahaũ	*dēkhē rahan* or *dēkhen rahai*
dēkhē rahai or *dēkhisⁱ rahai*	*dēkhē rahau*
dēkhisⁱ rahai	*dēkhinⁱ rahai*

The difference between this tense and the Past Indic. is that while the effect of the action denoted by the latter does not last beyond the time when the action took place that of the Past Perf. Indic. lasts. Moreover, the Past Indic. refers to nearer past time than the Past Perf. Indic. does, e.g. *mai gā̃wai* *gayeū̃*—I went to the village and *mai gā̃wai gawā rahaū̃*—I was gone to the village.

Note.—The English Past Perf. (e.g. I had gone) requires comparison with another past verb, but here it is not necessary.

§ 86 Future Perfect Indicative.

dēkhē hoihaū̃	*dēkhen hoibā* or *dēkhē hoibā*
dēkhē hoihai or *dēkhis‘ hoihai*	*dēkhē hoihau*
dēkhis‘ hōī	*dēkhin‘ hoihaī̃*

This tense refers to an action which will be necessarily completed by some particular time in the future, e.g. *jab tum hamkā bolāwai aihau tab ham rōṭī khāi lihē hoibā*—I shall have dined when you come to call me It may, however, sometimes denote a possible but uncertain action of the past, e.g. (*kalhi kā tum ī kursī par baiṭhē rahau*) *hā̃ baiṭhē hoibā*—(was it you who sat on this chair yesterday ?) yes, I may have sat on it

§ 87. Present Perfect Conjunctive.

dēkhē hōū̃	*dēkhē hōī* or *dēkhen hōi*
dēkhē hōi or *dēkhis‘ hōi*	*dēkhē hōu*
dēkhis‘ hōi	*dēkhin‘ hōī̃*

This tense refers to a conditional action, completed in the past or the future, e.g *jō ham yā kitāb chuyē hōī tau mārau*—beat me if I have touched this book, or *jō ham yā kitāb chuyē hōī tau māreu*—beat me if you ever find that I have touched this book.

§ 88. Past Perfect Conjunctive.

dēkhē hōtiū̃	*dēkhē hōten* or *dēkhen hōten*
dēkhē hōt‘, *dēkhis‘ hōt‘*	*dēkhē hōtiu*
dēkhis‘ hōt‘	*dēkhin‘ hōtī̃*

This tense refers to a conditional completed action in the past which did not occur, e.g *jo mai chuṭṭin mə sabai kitābai paṛhi ḍārē hōtiū̃ tau āju cain kart‘ hōtiū̃*—if I had finished reading all the books during the vacations, I should have been enjoying this day.

Infinitival Forms.

§ 89. The infinitive has two cases—direct and oblique. The dir , e.g. *dēkhab*—to see (*ghar kī dasā dēkhab kā rōwab hai*—to see the condition of the house is to weep ; *khāb kā pēṭ‘ bharab hai*—it is not eating but filling the belly). The obl., e g. *dēkhai* (*yū laṛikā dēkhai sunai mə nīk hai*—this boy is said to be good, lit. this boy is good in seeing and hearing, *abhai pānī barsai mə kuchu din aur bākī haī̃*—there are still some days before it rains).

§ 90. The noun of agency ends in *-aiyā*, e.g. *dekhaiyā* (one who sees); *hãsaiyā* (one who laughs); *kōī pānī bharaiyā milai tau layāwō*—bring a drawer of water if you find one, *kōī sahar jawaiyā hai*—is there any one who is going to the city?

§ 91. The Conjunctive Participle is formed by adding *i* to a root and using the form with *kə* or[1] *kai*, e.g. *dēkhi kə*—having seen, *hãsi kai*—having laughed, *wū sab din hãsi kai bāt kahat*^{i} *hai*—he always smiles before speaking (lit. having smiled, he speaks).

Note.—The simple Conj. Part. in *i* (without *kə* or *kai*) is used only in periphrastic formations.[2]

§ 92. The imperfect participial adjective generally ends in—*at*^{i}—the first form of the participle and does not change for number, person or case, e.g. *ham ēk uṛat*^{i} *kauwā dēkhen*—I saw a crow flying, *ham ēk uṛat*^{i} *ciraiyā dēkhen* : *uṛat*^{i} *kabutaran par gōli na calāō*—do not shoot at flying pigeons. When used with a fem. obl. noun, however, attributively it has the—*ətī* (third form of the participle) form, e.g. *uṛətī ciraiyā* (or *ciraiyan*) *par gōlī na calāō*—do not shoot bullets at the bird which is flying (or the birds which are flying).

Note.—This part. adj. is used predicatively when emphasis is laid on the action denoted by it (as distinguished from the substantive which it qualifies), e g. *ham ēk kauwā uṛat*^{i} *dēkhen.* Here the emphasis is on *uṛat*^{i} and not on *kauwā*.

§ 93. Below is given a complete scheme of the conjugation of *dēkhab*; only the 1st pers. sg. of tenses being shown.

	Indic.	Conj.	Imperative
Simple			
Present	*dēkhaũ*	*dēkhaũ*	*dēkhaũ*
Past	*dēkheũ*	*dekhətiũ*	
Future	*dekhihaũ*		
Periphrastic			
(*a*) with the Imperf. Part.			
Pres. Imperf.	*dēkhat*^{i} *haũ*	*dēkhat*^{i} *hōũ*	
Past Imperf.	*dēkhat*^{i} *rahaũ*	*dēkhat*^{i} *hōtiũ*	
Fut. Imperf.	*dēkhat*^{i} *hoihaũ*		
(*b*) with the Perf. Part.			
Pres. Perf.	*dēkhē haũ*	*dēkhē hōũ*	
Past Perf.	*dēkhē rahaũ*	*dēkhē hōtiũ*	
Fut. Perf.	*dēkhē hoihaũ*		

Dir. Inf. *dēkhab*; Obl. Inf. *dēkhai*; Noun of Agency—*dekhaiyā*; Conj. Part. *dēkhi kə*; Imperf. Part. adj. *dēkhat*^{i}, *dekhətī*.

Vide Chap. I § 8.

[2] *Vide* below §§ 116–117.

Transitive and Intransitive.

§ 94. Verbs are either trans. or intrans. Some trans. verbs can, however, be also intrans., e.g. *khāb*—to eat, *gāwab*—to sing. Similarly some intrans. verbs can be also trans., e.g. *hãsab*—to laugh at.

§ 95. The intrans. verb, e.g. *marab* (to die) differs from the trans., e g *dēkhab* in the Past Indic. and Perf. Part. as shown below :—

Past Indicative.

sg. masc.	sg. fem.	pl. masc.	pl. fem.
mareũ	*mariũ*	*maren*	
marā	*marī*	*mareu*	*mariu*
marā	*marī*	*marē*	*marī*

Note.—*marā*, *marī* sometimes are employed in the 1st sg. also.

Perfect Participle.

The perfect participle has four forms : (*a*) in *-ā* (e g *marā*) used as masc. sg ; (*b*) in *-ē* (e g. *marē*) used as masc pl. ; (*c*) in *-ī* (e.g. *marī*) used as fem. sg. and pl. and (*d*) in *-en* (e.g. *maren*) a common gender alternative form of 1st pl.

General Rules of Conjugation.

§ 96. Subject to the general rules given below all transitive roots are conjugated like *dēkhab* and intransitive like *marab*.

§ 97. All roots ending in *r*, *l* or *n* optionally elide initial *-a* or *-ə* of terminations, e.g *mān-* + *at'* = *mānat* or *mānt'*, *cal-* + *ətī* = *calətī* or *caltī*.

§ 98 Intrans. roots which contain a long syllable (e g. *lāg-*, *baiṭh-*, *sarmā-*) optionally elide the terminations *-ā* and *-ē* and substitute ' for *i* (in fem. sg) of the Perf. Part and Past Indic., e g. *lāgā* : *lāg*, *baiṭhē* : *baiṭh*, *lāgī* : *lāg'*, *baiṭhī* : *baiṭh'*.

Note.—roots in *-ā* before accepting the above change insert *n-* in between the root and the termination, e g. *sarmānā* : *sarmān*, *sarmānī* : *sarmān'*.

§ 99. Trans. roots in *-a-*, *-ā-* and *-ē-* add *-w-* before a termination with initial *a-* or *ā-* (e.g. *kurawat'* *kurawā* ; *bajāwat'*, *bajāwā* ; *khēwat'*, *khēwā*) and substitute *u-* for initial *ə-* (e.g. *kurautī*, *bajautī*, *kheutī*) ; Pres. Indic. 2nd pl. ends in *-ō* beside *-au*, e.g. *lāō*, *pāō*.

§ 100. Intrans. roots in *-a-* and *-ā-* add -w- before a termination with initial *-ā-* (e g *bhawā*, *gawā*, *sarmāwā*) and combine final ă of the root with initial *-a-* or *-ə-* of terminations (e g. *sarmāt'*, *sarmātī*). They, however, add -w- before *-aiya* (e g *sarmawaiyā*).

Note.—All intrans. roots in *-ā* except monosyllabic ones (e.g. *nā*—to pour, *ā*—to come) optionally insert *-n-* between the root and a termination of the Past Indic. and Perf. Part., e.g. *sarmānā*: *sarmāwa*, *dekhānī*: *dekhāī*, *lonāneu*: *lonāeu*, but *nāwā*, *nāī*, *nāeu*.

§ 101. All roots in *-i* combine their *-i* with *i-* or *ə-* of dissyllabic terminations into *ī*, e.g. *ji* + *ətī* = *jītī*, *ji* + *ihaū* = *jīhaū*; but *ji* + *ib* = *jiib*, *ji* + *it*^{i} = *jiit*^{i}.

§ 102. All roots in *-u* combine their final *-u* with initial *ə-* or *u-* of terminations into *ū*, e.g. *chu* + *ətī* = *chūtī*, *chu* + *u* = *chū*.

§ 103. All roots in *-ō* substitute *u-* for *ə-* of terminations, e.g. *rō* + *ətī* = *routī*.

Irregular Verbs.

§ 104. *kar-* (*karab*—to do) has an alternative root *kih-* for Past Indic. Perf. and Passive Participles (e.g. *kihē*) ; conj. part. is *kai*.

ā- (*āwab*—to come) takes *-w-* before a termination with initial *a-* or *ā-*, substitutes *u-* for *ə-* and has Pres. Indic. 2nd pl. in *-ō* or *-au* like trans. verbs while *khā-* (*khāb*—to eat) takes the changes of the intrans. roots in *-ā-*. *jā-* (*jāb*—to go) and *hō-* (*hōb*—to become) become *ga-* and *bha-* respectively for forming the Past. Indic. and Perfect Participles. They also have the following optional forms in them · *gawā* : *gā*, *bhawā* : *bhā*, *gayē* : *gē*, *bhayē* : *bhē*, *gaī* (sg.): *gai*, *bhaī* (sg) : *bhai* ; conj part. of *hōb* is *hoi* ; *lē-* (*lēb*—to take) and *dē-* (*dēb*—to give) elide initial *a-* and *ə-* of terminations (except of *-aiyā* : *lewaiya*, *dewaiyā*) make Past Indic., Perf. and Pass. Part. with *lih-* and *dih-* and form the Fut. Indic. irregularly as shown below ·—

lyāhaū	*lēbā*, *lēib*
lyāhai	*lyāhau*
lēī	*lyāhaī*

Similarly *dē*—: conj. part. *lai* and *dai* respectively. For the rest all roots are regularly conjugated.

PASSIVE VOICE.

§ 105. The active voice is more generally used than the passive. If the latter is used it mostly lays emphasis either on the object of the active construction (e.g. *ab sab ḍākū māḍḍārē jaihaī*—now all the robbers will be killed) or its attribute (e.g. *yā ḍhōl phūṭi janāt*^{i} *hai*—this drum appears to be broken) or on the action itself (e.g. *mai sē cillāwā nāī jāt*^{i} *hai* —— I cannot cry out). It almost always ignores the agent which if expressed is given only a secondary importance in a sentence.

§ 106. The passive is generally expressed by combining the passive participle with the forms of *jāb*—to go. There are three forms of this participle : (*a*) in *-ā* (masc. sg.); (*b*) in *-ē* (masc. pl.) ; (*c*) in -*ī* (fem. sg. and pl.). For example the forms of Passive Present Indicative of *dēkhab* are :—

sg. masc.	sg. fem.	pl. masc.	pl. fem.
dēkhā jāũ	*dēkhī jāũ*	*dēkhē jāī*	*dēkhī jāī*
dēkhā jāi	*dēkhī jāi*	*dēkhē jāu*	*dēkhī jāu*
dēkhā jāi	*dēkhī jāi*	*dēkhē jāī*	*dēkhī jāī*

§ 107. The impersonal passive of intrans. verbs is formed by combining form (*a*) in -*ā* of the pass. part with the forms of *jāb*, e.g *mai sē khāwā nāī jāt*^{i} *hai*—I cannot eat, *tum sē thāṛh thāṛh dēkhā jāt*^{i} *hai hiā s*^{e} *jāwā nāī jāt*^{i}—you can look on standing from there but you cannot go from here.

Note.—This construction expresses ability or inability of the agent to do an act

§ 108. A kind of intrans. passive is formed sometimes by adding -*ā* to certain trans. roots and then conjugating them like intrans. roots, e.g. *yū admī andhā dekhāt*^{i} *hai*—this man seems to be blind, *yū tamāsā pāche s*^{e} *nīkī tanā dekhāt*^{i} *hai*—this show can very well be seen from behind

Note 1.—This construction is found only with a definite number of verbs—those which denote perception or knowledge, e.g. *dekhāb*—to be seen or to appear, *sunāb*—to be heard, *janāb* —to seem.

Note. 2—The same construction applies in the case of denominative verbs, e.g. *lonāb*—to taste saltish, *miṭhāb*—to taste sweet, *khaṭāb*—to appear to be sour, *hariyāb*—to become green.

Note 3.—Termination -*ā* is common both to this construction and to the causative; but the former is conjugated as an intrans. root, the latter as a trans. one.

§ 109. A common periphrastic passive is formed by using the forms of *āwab*—to come, after the loc. of the inf. and the gen. of the agent if expressed, e.g. *jō yā bāt tumharē sunai mə āwai*—if this is heard by you.

§ 110. Another passive sometimes used is formed by combining the simple conj. part. with *parab*—to fall, e.g *ais sunipart*^{i} *hai ki pāñchā bars bādi laṛāī phiri sē hōī*—it is heard (i.e. men say) that war will again break out after five or six years.

§ 111. The passive participial adjective takes the ordinary terminations of the adjectives, e.g. *dēkh*—masc. dir., *dēkhē*—masc. obl., *dēkh*^{i}—fem. dir., *dēkhī*—fem. obl. For instance *yū tamāsā hamār dēkh hai*—this show is one that I have already seen.

Causative.

§ 112. A causative is generally formed by adding -*ā* to a simple root and then conjugating it like the regular trans. root in -*ā*-, e.g. *hāsab* : *hāsāwab*, *khāb* : *khawāwab*.

§ 113. There are some verbs, however, which form their causative by modifying the vowel of the root :—

(1) by lengthening it, e.g. *pasar-* : *pasār-*, *ukhar-* : *ukhār-*, *nikar-* : *nikār-*, *khĩc-* : *khī̃c-*. Similarly *bā̃dh-*, *lad-*, *mar-*, *kaṭ-* ;

(2) by changing *i* and *u* into *ē* and *ō* respectively, e.g. *ruk-* : *rōk-*, *khul-* : *khōl-*, *ghur-* : *ghōr-*, *jur-* : *jōr-* ;

(3) some verbs modify a consonant as well as the vowel, e.g. *phat-* : *phār-*, *chūṭ-* : *chōr*, *juṭ* : *jōr-*, *phūṭ-* : *phōr-*, *ṭūṭ-* : *tōr-*, *ghul-* : *ghōr-*, *bik-* : *bē̃c-*, *rah-* : *rākh-*.

Note.—All these (except *nikar-* : *nikār-*, *mar-* : *mār-*, *ruk-* : *rōk-*, *rah-* : *rākh-*) are sets of passive-active verbs rather than simple-causative, e.g. *katab*—to be cut, *kāṭab*—to cut, *birwā kaṭi gawā hai*—the tree has been cut

§ 114. A double causative is formed by adding *-wā* to the simple causative and then conjugating it like ordinary trans. roots in *-ā-*, e.g *hãsāwab* : *hãsawāwab* Roots in *-ā-*, *ē-* and *-ō-* (which add *-wā* to form the simple causative) do not take any termination to form the double causative. Their simple and double causatives coincide, e.g *khāwā-*, *sarmāwā-*, *lēwā-*, *rōwā-*.

§ 115. Where a double causative exists the simple one is used generally when the remote agent actively helps the immediate agent to do the action, e g. *gopāl rammu kə pānī piyāis^e*—Gopāl caused Rammū to drink water (i.e. Gopāl actively helped Rammū—perhaps by giving him water); and the double if the remote agent does not actively help but only directs the action to be done, e.g. *gopāl kallu s^e rammu kə pānī piyawāis^e*—Gopāl directed Kallū to cause Rammū to drink water In other words, while there are only two agents with a simple causative, there are at least three for a double one.

Note 1.—The difference between the two causatives is not generally marked, however, and either can be used.

Note 2—Verbs which form the causative by modifying the vowel have in effect four forms, e.g., *kaṭ-* : *kāṭ-* : *kaṭā-* : *kaṭawā-*.

Compound Verbs.

§ 116. Compound verbs are more commonly used than simple verbs and they express various shades of meaning. There are three different forms of the principal verb with which other verbs are compounded :—

(*a*) the simple conj. part. in *-i*, e.g. *giri parā*.
(*b*) the obl. inf. in *-ai*, e.g. *girai dēu.*
(*c*) the first pass. part. in *-ā*, e.g. *girā karau.*

§ 117. Form (*a*) is combined with

(1) *jāb*, *cukab*, *lēb* and *ḍārab* to express definite completion of an action, e.g. *hamār ghar jari gawā*—my house was burnt down, *jab mai khāi cukaũ*—when I finish dining, *jab mai kāsī āi lēũ tab tum huā̃ s^e jāyeu*—you can leave when I

have actually reached Kāsī, *wū cāri gilās pānī pī ḍāris^{i}*—he drank up four whole glasses of water.

Of these *cukab* expresses an additional sense of thoroughness and completion. and *ḍārab* that of unexpected completion of a difficult task;

(2) *parab*, *uṭhab*, *baiṭhab* to express suddenness or surprise, e.g. *wū pāgal āgi mə kūdi parā*—that mad man jumped into the fire, *tum ettē jōr s^{e} bōleu ki laṛikā jāgi uṭhā*—you spoke so loudly that the child woke up, *āju mai pā̃cai bajē uṭhi baiṭheũ*—I got up at five this morning;

(3) *sakab* and *pāwab* to express ability to do an act, e.g. *mai din bhare mə pacīs mail jāi sakat^{i} haũ*—I can walk twenty-five miles a day, *jò mai tum kā māri pautiũ*—if I could beat you;

(4) *khāb* and *mārab* to express offence or infliction of an undesirable thing, e.g. *wū mai kā dā̃t s^{e} kāṭi khāis^{i}*—he bit me with his teeth, *ham das pannak^{i} ciṭṭhī likhi māren*—I wrote out a letter of ten pages;

(5) *calab* to express the beginning of an action, e.g. *wui ham kā dekhatai māri calē*—no sooner did he see me than he began to beat;

(6) *dēb* to express intensity of an action, e.g. *mōri bā̃h chā̃ṛi dēu*—leave my arm.

§ 118. Form (*b*) is combined with

(1) *dēb* to express permission, e.g. *mai kā rōṭī khāi dēu*—let me eat my food;

(2) *lāgab* to express inception of an action, e.g. *wū ab hamarē hiā̃ āwai lāg hai*—he has begun coming to my house;

(3) *cahab* to express near completion, e.g. *bārā bajai cahat^{i} haĩ*—it is about twelve.

§ 119. Form (*c*) is combined with *karab* to denote frequentative action, e.g. *wui hiā̃ āwā kart^{i} haĩ*—he frequently comes here.

§ 120. A compound verb differs from the simple inasmuch as it expresses a more definite and sometimes a little modified action. Of the auxiliary verbs noted above only *cukab*—to finish, *sakab*—to be able to, *lāgab*—to begin and continue, and *cahab*—to wish, retain their original meaning, others have entirely lost it in helping out the meaning of the principal verb.

§ 121. The auxiliaries are used with different verbs but being idiomatically used, they cannot be combined with any and every verb. Their use is limited.

CHAPTER VII.

INDECLINABLES.

Adverbs.

§ 122. Adverbs are generally based on nouns (e.g. *jaldī*—soon), pronouns (e.g. *jaisē*—as), adjectives (e.g. *pahilē*—before) or ancient adverbs (e.g. *āju*—to-day) or adverbial expressions (e.g *tahi kai*—then).

§ 123. Adverbs of Time

(*a*) based on nouns, e.g. on *sā̃it‘* (moment)—*ī sā̃it‘* (just now), *tī sā̃it‘* (then), *jī sā̃it‘* (when—relative) *kī sā̃it‘* (when?), *wui sā̃it‘* (then); *jaldī*, *phurtī* or *caṭkaī* (soon); *dēr s‘* (late), *ettī dēr mə* (meanwhile). *sab din* (always);

(*b*) based on adjectives, e.g. *pahilē* (first), *āgē* (formerly), *pāchē* (after. afterwards);

(*c*) other adverbs—*āju* (to-day), *kālhi*, *kallhi* (yesterday or to-morrow), *paraũ* (day before yesterday or after to-morrow) *naraũ* (two days before yesterday or after to-morrow), *sadā* (always); *ab* (now), *tab* (then), *jab* (when—relative), *kab* (when?); *abhaū̃* (even now), *tabhaū̃* (even then), *kabhaū̃* (ever), *abhayen* (just now), *tabhayen* (just then), *jabhayen* (just when), *tahi kai* (then), *abhai*—yet, now; *abtī* or *abkī*, this time; *jalē*—until, *talē*—till then, *tau*—then; *bādi* or *bādi kə*—after.

§ 124. Adverbs of Place

(*a*) based on nouns—*wār* (side) combined with the pronominal adjectives *jī*, *tī*, etc., denotes direction, e g. *ī wār*—(on this side), *tī wār*, *wui wār*. *jī wār*, *kī wār*; *bīc mə*—(in the middle);

(*b*) based on pronouns—*hiā̃* (here), *huā̃* (there), *jahā̃*.. *tahā̃* (where..there), *kahā̃* (where ?); *aisī* (on this side), *waisī* (on that side), *jaisī*..*taisī* (on the side on which), *kaisī* (on which side ?);

(*c*) other adverbs—*bhītar* (within), *bāher* or *bahirī* (out side), *uppar* (above), *khālē* or *nīcē* (below), *āgē* (before), *pāchē* (behind), *nērē* (near), *dūri* (at a distance, far). *pallē* (beyond).

§ 125. Adverbs of Number.

The sense of once, twice, etc., is expressed with the help of some such noun as *dā̃ī*[1], e.g. *bahut dā̃ī* or *baudhā* (often); *kabhaū̃ kabhaū̃* (sometimes—every now and then); *dosarāi kə*—second time, *tisarāi kə*—third time.

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[1] *Vide* Chap. IV § 44.

§ 126. Adverbs of Manner

(*a*) based on nouns—by combining *tanā* (kind) with some adjective, e.g. *ī tanā* (in this way), *acchī tanā* (well), *burī tanā* (badly); *hālī* (rapidly), *dhīrē* (slowly);

(*b*) based on pronouns—*aisē* (in this manner), *waisē* (in that manner), *jaisē.. taisē* (in the manner in which) *kaisē* (how ?).

§ 127. Adverbs of Quantity,

e.g. *aur* (more), *bahut* or *jādā* (very, much). *kam* or *tanik* (a little), *kuch** *kuch** (somewhat), *ādhā* (half); *jettā*, *etta*, etc.

§ 128. Adverb of Reason

kāhē—why.

§ 129. Adverbs of Affirmation or Denial

hā̃ (yes), *nāī* or *nāhī* (no, not), *na* (no, not), *birkulli* (not at all).

§ 130. Compound Adverbs,

e.g. *jahā̃ tahā̃* (here and there), *jahā̃ jahā̃* (wherever), *jab jab ..tab tab* (whenever..then); cf *gā̃w gā̃w*—in every village; *kaiseu* (somehow); *kaisiu* (on some side), *kahū̃* (anywhere, somewhere): with conjunction *cahai*, e.g. *cahai jahā̃* (where-ever), *cahai jab* (whenever), *cahai jaisē* (howsoever), *cahai jaisī* (on whichever side).

§ 131. Comparison is expressed in the same manner as that of adjectives [1] e.g. *mai yū kām tum sē jaldi kai sakat' haū̃* —I can do this thing earlier than you can.

§ 132. Adverbs of time and place can generally be employed with *sē* (s^e) to denote the sense of 'from' or 'with' or with *kā* (*kə*) to express the meaning of 'of,' e.g. *ab sē ais kām na kiheu*—do not do such a thing from now; *hiā̃ s' calē jāu*—go away from this place; *kahā̃ kə ām lāyeu*—the mango of which place have you brought?

Note—Where English uses an adverb (e.g. very, much) to modify an adjective, this dialect uses the ordinary adjective. e.g. *yū gagarā baṛā garū hai*—this jar is very heavy, *yā bālṭī baṛī garuī hai*—this bucket is very heavy; *jais' acchī wā meharuā hai tais' ī sahar mə kōī nāī*—no lady is as good in this town as she is; *wui ādhē mā̃dē haĩ ādhē nīk haĩ*—he is half ill and half well.

Emphatic Forms.

§ 133. Emphatic forms of some adverbs (e.g. *ab*, *tab*) are irregular and generally modify their meaning very much. They are, therefore, given with each adverb Other adverbs like *āj** add the ordinary terminations, e.g. *ājai*, *ājui*.

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[1] *Vide* Chap. III § 40.

Postpositions.

§ 134. A postposition is generally used to denote a case-relation other than the nominative. It is used with the obl. case if one exists, otherwise with the direct, e.g. *rāja kə*, *rājan* s^e, *sab mā*, *acche* s^e, *khāi mə*.

§ 135. Accusative-dative—*kə* or [1] *kā*, e.g. *rāmū gopāl kə māris*^{i}—Rāmū beat Gopāl, *hari kə kuch*^{u} *khāi kə dēu*—give Harī something to eat.

§ 136. Instrumental-ablative—s^e or [1] *sē*, e.g. *wū tum kā kī sē pīṭis*^{i}—with what did he beat you ?, *bādar* s^e *būdī bhuī par girtī haī*—showers fall from the clouds on the earth.

§ 137. Locative—*mə* or [1] *mā*, *mahiyā̃*; *pə*, *par*, e.g. *khēt mə gāi cart*^{i} *hai*—a cow is grazing in the field, *khirkiyā par* (or *khirkiya pə*) *kauwā baiṭh hai*—a crow is sitting on the window.

§ 138. Genitive—*kə* or [1] *kā*, *kēr*—masc. dir , k^e or [1] *kē*, *kērē*—masc. obl., k^i or [1] *kī*, *kērī*—fem. dir. and obl.

Note.—The genitive postpositions agree in gender and case with the noun or pronoun which follows them, e g. *hari kə laṛikawā mari gawā*—Hari's son died. *hari* k^e *laṛikā mari gē*, *hari* k^i *laūṛiā mari gaī*.

§ 139. Dative—*khātir*, *badi* ; either of these may be used after the genitive of a noun or pronoun, e.g. *hari* k^i *khātir ham dūdh*^{u} *liyē jāit*^{i} *hai*—I take milk with me for Harī, *tumharī khātir dūdh*^{u} *liyē jāit*^{i} *hai.*

§ 140. Illative—*mārē* (on account of, owing to) follows a noun or pronoun in the genitive, e.g. *rām l mārē sītā ban kā gaī*—Sītā went to the jungle on account of Rām, *tum hamarē mārē māru khāyeu*—you were beaten on my account.

Note.—There is a tendency, however, to use the dative and illative postpositions with a noun or pronoun without the genitive postposition. This, however, does not apply to those pronouns which have special genitive forms—in their case the words *khātir*, *badi* and *mārē* follow the genitive form always.

CONJUNCTIONS.

§ 141. Cumulative—*au* (and), e.g. *tum au ham dūnau janē bajārai calibā*—you and I both will go to the market, *wui hiā̃ āyē au chin bhari baiṭhi kə calē gayē*—he came here, sat for a while and went away.

§ 142. Alternative—*cahai . . . cahai* (either . . . or), e.g. *cahai hiā̃ baiṭhau cahai huā̃*—sit either here or there ; *na . . . na* (neither . . . nor), e.g *na ham hiā̃ baiṭhib na huā̃*—I shall sit neither here nor there ; *nāi tau* (otherwise, or)—*ham kā rupayā dēu nāi tau ham mārib*—give me money or I shall beat you ; *ki* (or), e.g. *sōwau ki jāgau*—do you sleep or are you awake ?

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[1] For the use of the short or long form see Chap. I § 8.

§ 143. Adversative—*lēkin* (but), e.g. *wui haĩ tau amīr lēkin dēt^{i} kōi kə ēk pāiu nāĩ*—he is rich but does not give even a pie to any body or though he is rich he does not, etc.

§ 144. Subordinative—*ki* (that), e.g. *ham kā wū batāis^{i} ki tumharē cōrī hoi gai*—he told me that a theft had occurred at yours; *wū kahis^{i} ki ham jaldī lauṭib*—he said that he would return soon; *jī mā* (so that, in order that), e g *wū dawāĩ khāi lihis^{i} jī mā caṭkaĩ nīk hoi jāi*—he took medicine in order that he might recover soon; *jō* (if, whether), e g. *jō mai sōwaũ tau māreu*—beat me if I sleep; *mānau* or *jānau* (as if), e.g. *tum rāti kə ais hallā macāyeu janau ḍākā parā hōi*—you raised such an alarm at night as if a dacoity had taken place.

Note.—All reported speech is direct and is introduced by *ki*, e.g *gopāl hari s^{e} batāis^{i} ki saṅkaṭā tumhār ṭabkā corāi lihis^{i}*—Gopāl told Hari that Saṅkaṭā had stolen his mangoes.

The beginning of the oblique construction may, however, be seen in such sentences as *gopāl mahi sē kahis^{i} ki tum hamār ṭabkā corāyeu*—(Hari meets Sankaṭā and says) Gopāl told me that you stole my mangoes.

APPENDIX (*a*).

GULGULĀWĀLĪ KATHĀ.

ēk rājā rahaī au mahtārī rahai au dulhin rahai. mahtārī rōju chappan parkāl k^{c} bhōjan banāwai au apnā khāi au apnē laṛika ko khawāwai. dulhin khātir ēk bejhari k^{i} rōṭī sēkai ādhī rōṭī au lōnu sabērē dēi au ādhī sañjha kə wui mārē gussa k^{c} rōṭī ḍeharia mə ḍāri dēī au lōnu gagari mə ṇāi āwaī. aisai kart^{i} kart^{i} bārā barsai gudari gaĩ. tab ēk din būṛhā gulgulā kihin^{i}. gulgulā jhāpi kə dhari dihin^{i} au apnā disai calī gaĩ. jāt^{i} beriā bahu s^{c} kahi gaĩ ki: "dulhin^{i} aisī dēkhē raheu." bahū jalē wui lauṭaī talē tīni gulgulā nikāri lihis^{i}. khāis^{i} nāī dhari āī. talē būṛhā āi gaĩ kullā ullā kai kai apan aṛhiyā dēkhin^{i} jāi tau kahin^{i}: "dulhin kā ī ma k^{c} gulgulā tum lihē hau." dulhin bōlĩ: "ham buā ham nāī lihen hai kā mālum bilaiyā lai gai hōi gai rahai wui wār." tau bilaiyā kahis^{i}: "rahu tui tui kā mai tīni pāni s^{c} na dhōi dēũ tau mai kāhe k^{i}. tui lihē au mai kā cōrī lagayē."

tahi kai jab sā̃jh bhai tab rānī apan^{i} khaṭiyā bichāin^{i} diā bāri kə dharin^{i}. jab rāja k^{c} kacehari s^{e} lauṭai mə dēr dēkhin^{i} tau kahin^{i}: "lāō talē sōi lēī." yū kahi kai sōwai lāgĩ. bilaiyā kā kihis^{i}. kōi k^{i} pagiā uṭhāi lāi au unkī khaṭiya pə dhari dihis^{i} kōi ki tarwāri lai kaihuāi dhar dihis^{i} au kōi k^{e} jūtā uṭhāi lāī so palka k^{e} nīcē dharis^{i} āi. attā sāmān dhari kai bilaiyā apnā calī gai.

rājā jab kacehari s^{c} āyē dēkhaī kā kōi k^{c} jūtā dharē kōi k^{i} tarwari kōi k^{i} pagiā. rājā man mā añjādē ki kōī mardu rānī tīr āwā hai tau āicin^{i} tarwāri ki īkā māḍḍaribā. tau diyā bōlā: "rājā samujhi kə māreu." "rājā tīni dāī tarwāri uṭhain^{i} au diyā tīniu dāī tirbācak dihis^{i}. tau rājā tarwāri dhar^{i} dihin^{i} au lōṭā lai kai pakhānē calē gayē.

ettī dēr mə rānī jāgi parī tau diyā baṛhāi dihin^{i}. dia k^{e} darwajje pə kuā̃ rahai rājā huāi kullā kart^{i} rahaī jab diyā apanē ghar pahũca tau mahtārī kahis^{i} ki: "bhaiyā āju baṛī dēr lagāyeu mai khāi kə lihē baiṭh^{i} rahiũ." diā kahis^{i}: "mahtariyā kuchu pũchau nā rānī par baṛī bipati paṛī hai" rājā ṭhāṛh hoi kai sunai lāg. mahtārī kahis^{i}: "kāhē bhaiyā?" diyā jais jais hāl^{u} bhawā rahai tais sab batāi dihisi. rājā sab suni kai ghar kā āyē au ōṛhi kə pauṛhi rahē

jab bhōru bhawā tau mahtārī phiri chappan parkāl k^{e} bhōjan banāin^{i} au kahin^{i}: "bhaiyā khāu āi." rājā kahin^{i}: "buā parsau." wui ēk thariā parsin^{i}. rājā kahin^{i}: "dosariu parsau" wui dōsari parsin^{i}. rājākahin^{i}: "tisariu parsau." būṛhā kahin^{i}: "āō ham tum khāī dulhin khāwā karihaī. tau rājā kahin^{i}: "nāī tisariu parsau." jab tisariu thariā parsi gai tau rājā kahin^{i}: "rānī khāu āi." rānī kahin^{i}: "sunau rājā bārā barsai bīti gaī tab na kabhaũ pũcheu āju kā hai" yũ kahi kai ḍeharia k^{i} rōṭī āgē kurai dihin^{i} au gagari kə lōnu ā̃gan mə nāi dihin^{i}. būṛhā māri kə khisiyāi gaī au wahē tīr mari kai rahi gaī. rājā rānī bahut din rāji kihin^{i}. jaisē unkē din bahurē taisē sab kē bahuraī.

Translation.

A story about *gulgulās*.[1]

There lived a certain king with his mother and wife. The mother used to prepare food of fifty-six varieties daily and she and her son used to partake of it. For the daughter in-law, however, she baked a loaf of millet and gave half a loaf and salt to her in the morning and half in the evening. She, on account of anger, threw the bread into a big earthen pot and poured the salt into a jar. In this way twelve years passed. One day the old lady prepared *gulgulās* She covered them and having done so she went out to ease[2] herself. While going she said to the daughter-in-law: "Daughter-in-law, keep an eye in this direction." Before the old lady returned, the daughter-in-law took out three *gulgulās*. She did not eat them but put them away. The old lady returned and after rinsing her mouth[3] went and looked at her wooden vessel.[4] Then she said : " Daughter-in-law, is it you who have taken the *gulgulās* from this ? " The daughter-in-law replied : " I, mother, I have not taken any. Who knows but that the cat may have taken them, she has been that way." The cat, then, said : " All right, you wretch, I am not a cat if I do not wash you out altogether[1] You took them and attributed the theft to me."

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[1] *gulgulā* is the name of a special Indian preparation made of flour and sugar, it is also called *puā* at some places.

[2] To go out or to go to the quarters (literary trans.) is a euphemism for attending to nature's call.

[3] To rinse the mouth, i.e. to wash the mouth, hands and feet.

[4] *aṛhiyā* is a big wooden vessel to put eatables in.

Thereafter when it became dark[2], the queen arranged her bedding and lighted the lamp. When she saw that there was some delay in the king's return home from the court she said to herself : " Let me sleep for a while." Having said so she went to sleep. And what did the cat do ? She brought somebody's turban and placed it on her bedstead and took somebody's sword and placed it there. She also brought somebody's shoes and put them under the bedstead. She put these things there and went away.

When the king returned from the court he saw that there were somebody's shoes and somebody's sword and turban. From it he concluded that some man had come to the queen. On this he drew his sword in order to kill her. The lamp spoke out : " O king, learn the truth before you kill her." The king thrice drew the sword out and the lamp forbade[3] him all the three times He then put down the sword, took the *lōṭā*[4] and went away to attend to nature's call.

Meanwhile the queen woke up and put out[5] the lamp There was a well before the door (of the house) of the lamp. The king was rinsing his mouth there. When the lamp reached home, his mother said : " My son you are very late to-day, I have all along been sitting with the food ready " The lamp replied : " Dear mother, do not ask anything, great calamity has befallen the queen." The king stood there and listened. The mother asked : " What is the matter, dear son ? " The lamp related everything that had happened. The king heard everything, came home and having covered himself up, lay down.

When it became morning, the mother again prepared food of fifty-six varieties and asked her son to eat it. The king asked her to serve She served one dish. He asked her to serve another. She served another. He asked her to serve a third. The old lady said to him : " Come, let us take our meal : the daughter-in law may eat food afterwards " But the king said. " No, serve a third dish also." When the third dish was also served, he asked the queen to come and eat. The queen replied, "Hear, O king, twelve years have passed and never did you ask me (to eat). What is the matter today?" Having spoken so, she brought out the bread from the earthen pot and put it all before him and poured out the salt from the jar in the courtyard. The old lady got very much ashamed and died on the very spot. The king and the queen reigned for many a day. May [1] everybody's good days return as did theirs.

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[1] *tīni pāni sᵉ dhōi dyāhaũ*—lit. shall wash you away with three waters, i.e. destroy you completely.

[2] Lit. when it became evening.

[3] *tirbācak dihisᵗ*—lit spoke three times, i.e. in a decisive manner.

[4] *lōṭā* is a small brass or bronze vessel to contain water.

[5] *baṛhāi dihinᵗ*—(lit. lengthened or developed) is a euphemism for extinguished.

BAHIRĀM COṬṬA K^i KATHĀ.

ēk rājā k^e cāri laṛikā rahaī. ēk din rājā cāriu kə bolāi kə ēk ēk s^e pū̃chin^i ki: " bhaiyā tum kī kī bhāgi s^e jiat^i hau." tīni laṛikā jo baṛē rahaī so kahin^i ki : " bappā ham tumharī bhāgi s^e jiit^i hai." jab chōṭē laṛika s^e pū̃chin^i : " bhaiyā Bahirām tum kī kī bhāgi s^e jiat^i hau," tau wū bōlā : " bappā sab kōī apanī apanī bhāgi s^e jiat^i hai." rājā yā bāt suni kai nākhus bhayē, kuchu bōlē nāī.

dosarē din jab cāriu bhāī sikār s^e lauṭē tau sipāhī kahis^i ki : " rājā kahin^i hai ki jaun hamarī bhāgi s^e nāi jiat^i haī taun mahal mə na ghusai au jo asil hōi tau hamarī rāji k^e bahirī anna jal karai." Bahirām huāi apanē bhāin kə salām kai kai cal dihā.

calt^i calt^i wū apanē bāp k^i rāji k^e bāher pahū̃cā. dēkhai kā ēk naddi k^e kinārē cāri pā̃c sipāhī bāccīt kai rahē haī caṭṭa nāu kə rūp dhari kai gawā au salām kai kai kahis^i ki : " bhaiyā hajāmat^i banawāi lēu." wahū kahin^i : " calau mauke pə nauwau āi gawā.' jab sab janē hajāmat^i banawāi kə nahāi khātir pāni mə ghusē tau Bahirām sab kē kapaṛā lai kai cal dihā. sipāhī jab pānī s^e bahirī āyē tau dēkhaī kā ki nauwā kapaṛā lai kai bhāggawā. man mā kahin^i ki : " bhāī din kā naṅgē jaihau tau sab janē hā̃sihaī rāti kə ghar caleu."

ī wār Bahirām sipāhin k^e ghar pahū̃cā au khabari kihis^i ki : " wui sab janē laṛāi mə mārē gayē ham unkē kapaṛā lāyen hai taun lēu." vū suni kai meharuā rōwai dhōwai lāgī̃. unkā samujhāis^i bujhāis^i au kahis^i : " bahinī rāti kə bhūt bani kai naṅgē naṅgē wui aihaī ḍerāyeu nā.

Bahirām huā s^e ēk mālin khiā̃ gawā au wui kā mausī banāi kə huā̃ ṭiki gā rāti kə jab sipāhī apanē ghar pahū̃cē tau meharuā unkā bhūt jāni kə mārai lāgī̃ jab sab hālu sunin^i tab man mā pachitānī̃ au mārab band kihin^i.

sabērē sipāhī rājā khiyā̃ gayē au kahin^i ki : ' hiyā̃ Bahirām coṭṭā āwā hai wui kā pakarau nāi tau sab kā wū hairān karī." rājā apanē darōga kə hukum dihin^i ki : " rāti bhare mə pakari lāō tau inām milī " darōgā rāti bhari ḍhū̃ṛhat^i rahā ēk tīr

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[1] This is the prayer with which every story ends. It shows that a story may relate unhappy events but always has a happy end.

Bahirām milā wui sē darōgā pū̃chis^{i} : "kahū̃ Bahirām coṭṭā dēkhē hau." Bahirām bōlā : "hā̃ abhai yahē wār gawā hai." darōgā aisī waisī phiri kai āyē au kahin^{i} : "kahū̃ milā nāī." Bahirām bōlā : "sāheb apan ghōṛā lāō mai abhayen ḍhū̃ṛhē lāwat^{i} haū̃." ghōṛa pə caṛhi kai mausī khiyā̃ āi gawā au sōi rahā. darōgā rāja s^{e} kahin^{i} ki : "wū tau mahu kə ṭhagi lai gā, mai nāī ḍhū̃ṛhi paihaū̃."

rāja kə wajīr kahis^{i} : "rājā āju rāti kə ham pakaribā." rāti kə sahar mə gast lagāwai lāg. Bahiramau huā̃ pahū̃cā ēk buṛhiyā cakiyā pīsat^{i} rahai bōlā : "buā tum thaki gaī hoihau lāō tumhār kapaṛā mai pahiri lēū̃ au pīsaū̃ tum jāu sōi rahau." būṛha k^{e} man kī hoi gai. Bahirām cakiyā pīsai lāg. thōrī dēr bādi wajīr āyē kahin^{i} : "buṛhiya ri buṛhiyā kahū̃ Bahirām coṭṭā dēkhē hai." Bahirām bōlā : "hā̃ sāheb abhai yahē tīr rahai." wajīr aisī waisī ḍhū̃ṛh^{i} kə phiri āyē au kahin^{i} : "kahū̃ milā nāī." Bahirām bōlā : "āō tum hamār kapaṛā pahini kə cakiyā pīsau mai pakarē lāwat^{i} haū̃." wajīr kə buṛhiyā k^{e} kapaṛā pahināi kə Bahirām un kē pahini lihis^{i} au mausī khiyā̃ āi rahā. jab buṛhiyā jāgī tab wajīr kə sab hāl^{u} mālum bhawā. māri kə khisiyāi gayē au rāja s^{e} jō bhawā rahai sab batāin^{i} jāi.

ab rāja k^{i} bēṭī kahis^{i} : "ham coṭṭā pakaribā." jab rāti bhai tab apanī khirkī mahiyā̃ baiṭhi gai au aisī waisī dēkhai lāg^{i}. Bahirām kā kihis^{i} rahai ki dinai mə kōī ghasiyarwa kə dahin hāth kāṭi lāwā rahai. rāti kə rāja k^{i} bēṭi k^{i} khirkiya k^{e} tarē ṭahalai lāg. bēṭī pū̃chin^{i} : "kaun hai." wū bōlā : "Bahirām." rāja k^{i} bēṭı sō̃cis^{i} ki : "jō hallā macāib tau yū bhāgi jāī lāō ī kā kōī tana s^{e} phā̃sī." bōlī : "āō ham tumharē uppar bahut khus han jaurī laṭkāit^{i} hai uppar caṛhi āō ham tum biyāhu kai lēī." Bahirām acchā kahi kai caṛhai lāg jab khirkī tīr pahū̃cā tau rāja k^{i} bēṭī wui kā ghāyel karai khātir tarwāri calāis^{i} Bahirām coṭṭā ghasiyarwā wālā hāth phē̃ki kə nīcē utari āwā au mausī khiyā̃ pari kai sōi rahā.

bhōr bhawā tau rājā̃ k^{i} bēṭī kahis^{i} : "bappā ham coṭṭā pakari lihen." rājā bōlē : "dekhāō :" wā bōlī : "yū dēkhau hāth kāṭi lihen hai bas^{i} jī kā hāth kaṭā hōi wahai Bahirām coṭṭā." rājā sahar bhare mə sipāhī daurāin^{i} au kahi dihin^{i} ki : ' jī kā hāth kaṭā pāō pakari lāō." sipāhī wahē ghasiyarwa kə pakari lāyē. wū dukhiyā rōwai lāg au sab hāl^{u} batāis^{i}.

rājā sahar bhare mə ḍhīṛhōrā piṭawāi dihin^{i} ki Bahirām ab āi jāi ham wui kē saṅgh biṭiya kə biyāhu kai dēib au ādhī rāji dai dēib. Bahirām ghōṛa pə caṛhi kai gawā au salām kihis^{i}. rājā wui kē saṅgh apan^{i} laū̃ṛiā bihāi dihin^{i} au ādhī rāji dai dihin^{i}.

jab Bahirām calā āwā tau wui kē bāp kə baṛā pachitāwā lāg k^{i} : "hāi ham apanē laṛika kə nikāri dihen." patā lagāwat^{i} lagāwat^{i} hiā̃ āwā. kahis^{i} : "bhaiyā tumahē sapūt hau ham tumahe kə rāji dēbā sā̃cu kahē rahau ki sab kōī apanī apanī bhāgi s^{e} jiat^{i} haī." yū kahikai chāti s^{e} lagāi lihis^{i}. jais unkē din bahurē tais sab kē bahuraī.

Translation.

Story of Bahirām the thief.

A certain king had four sons. One day he called all the four and asked them one by one: "Son, to whose fortune is it due that you live your life?" All the three elder sons said: "Father, it is due to your fortune that we live" When he asked the youngest: "Dear Bahirām, to whose fortune is it due that you live?," he replied, "Father. every one lives by means of his own fortune" The king was greatly displeased at this answer (but) he said nothing.

The next day when the four brothers returned from the hunt the sentinel said: "The king has ordered that he who does not live owing to the king's fortune. should not enter the palace and if he is true to his blood he should neither eat nor drink throughout his kingdom." Bahirām then and there said *salām* to his brothers and started from there

After going for some time he arrived beyond the kingdom of his father. What does he see? He sees four or five soldiers talking to one another on the bank of a river. At once he disguised himself as a barber, went there and gave them greeting. He said: "Brothers, get yourselves shaved" They also said: "Oh, the barber also has arrived at the right time." When all of them, after getting themselves shaved, entered the water to take their bath, Bahirām took all their clothes and went away. When the soldiers came out of the river they saw that the barber had run away with their clothes Then they said to themselves: "If we go naked during day time all will laugh at us: so let us go home at night."

On this side Bahirām reached the homes of the soldiers and sent the news in, that they had been killed in war and that he bad brought back their clothes. When the women heard this, they began to lament. Bahirām consoled them and said: ' Sisters, they will come to you naked at night as ghosts, do not get afraid."

From that place Bahirām went to a gardener's wife and calling her his aunt (lit mother's sister) stayed there At night when the soldiers reached home, their wives began to beat them taking them to be ghosts. When they heard every detail they regretted it and stopped beating

Next morning the soldiers went to the king and told him that Bahirām the thief had arrived there and that if he was not arrested he would trouble all very much. The king ordered his police officer to catch the thief the same night and promised him a reward. The police officer searched for him all night. He met Bahirām at one place and asked him if he had anywhere seen Bahirām the thief. Bahirām replied: "Yes, he has just gone this way." The police officer went hither and thither and coming back said: "I have not found him."

Bahirām replied: "Sir, give me your horse: I bring him immediately." Mounting on the horse he came to his aunt's and went to sleep. The police officer said to the king: "He has deceived me, also. I shall not be able to find him."

The king's minister said, "My lord, I shall arrest him this night." At night he began to go the rounds in the city. Bahirām also arrived there. An old woman was grinding corn: he said: ' Mother, you must have become tired, go and sleep. Come, let me put on your clothes and grind." That was the old lady's wish. Bahirām began to grind the corn. After a little while the minister came and asked: "O old woman, have you seen Bahirām, the thief, anywhere?" Bahirām said: "Yes, sir, he was here just now." The minister came back after searching here and there and said that he had not found him Bahirām said: "Come, put on my clothes and grind the corn. I will just bring him to you." He made the minister put on the old woman's clothes and himself put on the minister's and came away to his aunt's. When the old woman got up, the minister came to know everything. He was very much ashamed and went to the king and told him everything.

Now the king's daughter said: "I shall catch the thief." When night came, she sat at her window and began to look this way and that. And what did Bahirām do? During the day, he cut off a grass-cutter's right hand. At night he began to walk below the window of the king's daughter. The princess asked: "Who is it?" He replied: "Bahirām." The king's daughter thought: "If I raise an alarm, he will run away Therefore, let me entice him somehow or other." She said "come, I am very much pleased with you. I throw the rope you come up; we shall marry." Bahirām said. "Very well' and began to climb up. When he got near the window, the princess wielded her sword in order to wound him. Bahirām at once threw in the grass-cutter's hand, came down and went to his aunt's. There he went to sleep.

When the morning came, the princess said to her father: "Father, I have caught the thief." The king said: "Show him to me." She said: "just look here I have cut off his hand. He is surely Bahirām the thief whose hand this is." The king sent his sepoys throughout the city and asked them to bring every man whose hand was cut off. The sepoys brought the grass-cutter. The poor man began to weep and related everything.

The king proclaimed throughout the city by a beat of drum that Bahirām should present himself before the king now who would give his daughter to him in marriage and give him half his kingdom. Bahirām, mounted on a horse, went to the king and greeted him with *salāms*. The king gave him his daughter in marriage and bestowed on him half his kingdom also.

When Bahirām went away, his father regretted his action very much. He said: "Oh, I have turned out my own son." Searching here and there, he arrived here and said: "My son you are really a noble son. I shall give you my kingdom. You spoke the truth when you said that every man lives by his own fortune." Having said so he embraced him. May everybody's good days return as did theirs.

APPENDIX (*b*).

CHAND.[1]

1. "sōwau ki jāgau mōrī Ādhi Bhawānī,[2] jagat kērī rānī,
Akabar ṭhāṛhē duār, bali jāū̃.[3]"
2. "kī tum Akabar parchan[4] āyeu arē parchan āyeu kī
tum darsan[5] āyeu"; bali jāū̃.
3. "nā ham mātā mōrī parchan āyen arē parchan āyen nā
ham darsan āyen. bali jāū̃."
4. "ham tau mātā mōrī laṛne kə āyen arē laṛne kə āyen,
nikari na laṛau maidān, bali jāū̃."
5. "tumharē tau Akabar phaujai bahut haī are phaujai
bahut haī hamarē tau negulā[6] akēl," bali jāū̃.
6. "tumharē tau Akabar ḍhāl tarawariyā arē tōbai bandu-
khiyā hamarē phūlan kērī māl." bali jāū̃.
7. 'jāi kaheu wui Durgā[7] bahinin āgē, Angār[7] mātā āgē
wui sātau[7] bahinin āgē tābuan āgi uṭhāwaī," bali
jāū̃.
8. "jarai lāgaī tābuā kaṭan lāgaī ḍōrī, kaṭan lāgaī ḍōrī
tab ham Ādhi Bhawānī," bali jāū̃.
9. jarai lāgē tābuā kaṭan lāgī ḍōrī, kaṭan lāgī ḍōrī. "ab
ham Ādhi Bhawānī," bali jāū̃, "ab ham jagat
bhawāni," bali jāū̃.
10. Akabar bā̃dhi paṭiyā[8] laṛkāwaī paṭiyā laṛkāwaī bībi[9]
sē dānā darāwaī, bali jāū̃.

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[1] *chand* is the term used for the songs in praise of gods and goddesses, chiefly goddesses.

[2] *Ādhi Bhawānī*—name of one of the seven sisters—the healer of all pains.

[3] *bali jāū̃*— I adore, I bow; this is the burden of the song.

[4] *parchan* < Sanskrit *prakṣālana*; this signifies the special rite of pouring water—chiefly Ganges water—over the image of a god or goddess.

[5] *darsan* < Skt. *darśana*, visiting, seeing, used only of gods and saints and elders to whom respect is due.

[6] *negulā*—the name given to the single boy-defender of the goddesses, who remains always with them.

[7] The goddesses are seven in number and all of them are sisters born of the same parents; *Durgā*, *Angārmātā*, *Bhawānī* are three of them. Durgā is the goddess of small-pox, Angārmātā burns everything and Bhawānī is the healing goddess

[8] *paṭiyā* is the name given to the beams used to make a cot, there are four such in every cot. [9] *bībī*—wife, here the Queen.

11. " ham tau jānī mātā kā̃kar pāthar arē kā̃kar pāthar,
nikarī haī Ādhi Bhawānī bali jāū̃, nikarī haī jagat
bakhānī, bali jāū̃ "
12. " abtī bēr tum paljhau Bhawānī arē paljhau Maharānī
ab nāhī parbat āib, bali jāū̃, ab nāhī parbat āib, bali
jāū̃."
" sōwan ki jāgau mōrī Ādhi Bhawānī, jagat kērī rānī,
Akabar ṭhāṛhē duār hō, bali jāū̃."

Translation.

A song in praise of Bhawānī.

Note 1.—Bhawānī is one of the seven powerful goddesses. She is sometimes also identified with Bhawānī, Siva's wife. Her abode is on the hills. The story goes that once Akbar thought of throwing her image (usually of stone) out and so he went to the temple of the goddess. The present song is the dialogue between the two.

Note 2.—For the sake of rhythm the words in a song undergo some changes which are not generally visible in ordinary speech. For instance a short *a* is added to every word which ends in a consonant, final vowels are often lengthened and the long vowels in the middle of a word are often shortened.

Note 3.—The language of songs is often somewhat borrowed and archaic. For instance in verse 8 above we have the obl inf. in *-an* (*kaṭan*) side by side with *-ai* form (*jarai*).

1. " Are you sleeping or waking, my Ādhi Bhawānī, queen of the world. Akbar stands before your door, I bow to you."

2. " Akbar, have you come here for the sake of *parchan* or for *darsan* ?," I bow to you.

3. " My mother, I have come here neither to do *parchan*, yes to do *parchan* nor to have your *darsan*, I bow to you."

4 " My mother, I have come here to have a fight with you, yes to have a fight, why not come out and fight, I bow to you."

5. " You Akbar, you have many armies, yes many armies, while I have the solitary *Negulā*," I bow to you.

6. " You Akbar, you have shields and swords, yes rifles and guns, I have only the garland of flowers," I bow to you.

7. " Go[1] before sister Durgā, before Aṅgārmātā, yes before all the seven sisters and ask them to set fire to the tents," I bow to you.

8. " When the tents begin to be burnt, when the strings begin to be cut down, yes to be cut down, then shall I be Ādhi Bhawānī," I bow to you.

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[1] Bhawānī now sends her messengers to her sisters and it is not long before they arrive to help her.

9. The tents began to be burnt, the strings began to be cut, "Now I am Ādhi Bhawānī, now I am Bhawānī of the worlds," I bow to you.

10. They bind Akbar to a beam, yes let him hang there and make his wife grind corn, I bow to you

11 "Mother, I thought you were only gravel and stone, yes only gravel and stone, but you have come out to be Ādhi Bhawānī, yes come out to be the celebrated goddess of the world, I bow to you"

12. "Be pleased, O Bhawānī this time, yes pardon, O Empress of the world, never shall I come again to the hills, never shall I come again to the hills, I bow to you."

"Are you sleeping or waking, my Ādhi Bhawānī, queen of the world, Akbar stands before your door, I bow to you."

24. Father A. Monserrate, S.J., on Salsete, Chorão, Divar, and the Molucas (1579).

Edited and translated by the Rev. H. Hosten, S.J.

The following account about Salsete. Chorão, Divar, and the Molucas forms part of a long relation in Spanish, the first part of which is entitled: *Informacion de los X'pianos de S. Thome* The document belongs to the Society of Jesus, and is marked XVI (Goa. 33; foll. 149*r*–152*v*). I have deciphered and translated the whole of it from a photographic reproduction. I reserve the first part, on the Christians of St Thomas, for my studies on St Thomas the Apostle[1]; the second portion, on Salsete Chorão, Divar, and the Molucas (foll 151*r*–152*r*), being entirely irrelevant to those studies, deserves a permanent home elsewhere.

The relation is neither signed nor dated; luckily, the writing and the similarities between the account on the St. Thomas Christians and a letter dealing with the same subject and written by Father Antonio Monserrate, S.J., (Cochin, 12th January, 1579), of which I have a photographic facsimile, shows unmistakably that the author of the anonymous relation is Father Monserrate, and that the date is the same, to within a few days. It is an autograph, therefore. The letter from Cochin was addressed to the Very Rev. Father Everard Mercurian, the General of the Society of Jesus in Rome The relation, *Informacion de los X'pianos de S. Thome*, is likewise addressed to the General. The endorsement, in the author's writing, at the end of the document is: "Information concerning some Christianities of India. To be seen by our Father General."

Father Monserrate is the author of *Mongolicae Legationis Commentarius* (1590-91), which we published for the Asiatic Society of Bengal,[2] and of a *Relação do Equebar* (1582), which we published for the same Society.[1] We need not therefore enlarge on his career or on his merits. Those who have read his writings on Akbar will find him not less painstaking in the fragment we now offer here. His relation on the St Thomas Christians is as valuable as all his other writings.

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[1] In 1921 (July 17)-1922 (April), I have published in *The Catholic Herald of India* (3 & 4, Portuguese Church Street, Calcutta), tentative articles on a number of archæological finds from Mylapore which throw new light on the question of the traditional apostolate of St. Thomas in India. I am engaged now on a second series of articles dealing with other questions regarding the same problem A third part will embrace translations of texts from early travellers and the best accounts of Mylapore and of the St. Thomas Christians as found in the Portuguese historians and early Missionaries. Much new material has been secured.

[2] Cf. *Memoirs A.S.B.*, quarto, Vol III, No. 9, pp. 518-704: Calcutta, 1914

Father Monserrate's writing in this document is a very microscopic one. The whole Spanish text which we publish here fits in 2⅝ of his pages (23 centim. × 15½ centim.); yet, he wrote so clearly that, in spite of my very limited knowledge of Spanish, I have had but little difficulty in deciphering him tolerably. Even the more diminutive writing added between the lines or running down the margins yields its mysteries to the unaided eye.

For want of books I cannot here annotate this fragment as fully as I might have wished. I trust, however, that Monserrate's description of customs will be found on the whole fairly accurate. It is the more valuable as it is one of the earliest of its kind for Goa and its neighbourhood; and we cannot but regret again that three MS. volumes by Monserrate are lost or in hiding, viz. his book on the geography, natural history, customs and antiquities of India, his similar volume on Arabia and his account of his captivity in Arabia.

I publish the Spanish text as I find it, with the exception that I punctuate it more copiously, use more capitals, and divide it into paragraphs.

Darjeeling, St. Joseph's College,
18th June, 1922.

We have translated and published the whole of that important volume on the first Jesuit Mission at Akbar's Court (1580–1583) in *The Catholic Herald of India*, a weekly paper, Calcutta, in 1920–21. We delay publishing it in book-form, because we have not here the leisure and the means to annotate it as it deserves, and because a large number of subsidiary materials of the same period ought to be published simultaneously.

[1] Cf. *J. and Proc. A.S.B.*, 1912, pp. 185–221: title: "Father A. Monserrate's Account of Akbar (26th Nov., 1582)."

[*Fol 151v.*]

IHS.

Informacion de la Isla y Xpiandad de Salsete.

La Isla de Salsete esta a la p^{t} del Sul, saliendo de la varra de Goa. Confina por vna p^{e} con tierras del Hydalcan, y por otra con la mar. Tiene de cumplido .6. leguas y dos de ancho. Rende esta isla alrey 40000 pardaos. Tiene .66. aldeas, las quales se reducen a 12, q′ son sus cabecas, las quales se llaman la camara general. Tiene este nombre, porq′ ellas son solam^{e} las q′ goviernan la isla toda y todo el Conchan, por esta manera de cada vna destas .12 aldeas se juntan dos hombres en vn cierto lugar con su escriuano, y alli, como en conseso, asientan lo q′ se a de hazer y es necess^{o} p^{a} el bien publico y p^{a} arecadar el fuero y renda[1] de S.A. Despues de asentado lo q′ se a de hazer, da el escriuano vn grito como pregonero en almoneda (y esto llaman nemo), q′ es comũ consentim^{o} de todos; y si vno solo faltare y no le paresciere bien, no se puede effectuar nada; y de lo q′ se asienta solam^{e} da fee el escriuano, sin firmarse ninguno

(*Fol. 151v.*)

JESUS.

Information on the Island and Christianity of Salsete

The Island of Salsete is on the South side as one comes out of the bar of Goa. On one side it borders on lands of the Hydalcan; on the other, on the sea. It is 6 leagues in length and two in breadth. This island yields to the king 40,000 pardaos. It has 66 aldeas [villages], which are reduced to 12,[1] which are their capitals, and are called the General Chamber. It has this name, because they are the ones who alone govern the whole island and the whole of the Conchan, in this manner: two men from each of these 12 aldeas assemble in a certain place with their scrivener and there, as in a meeting, they settle what has to be done for the common weal and to obtain the quit-rent and revenue of His Highness.[2] When they have settled what has to be done, the scrivener gives a shout, like a crier at an auction, (and they call this *nemo*), which is their common agreement. And, if only one should fail and he should not approve of it, nothing can be done: and the scrivener alone

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[1] First: renta.

[1] Here again we might see a case of the sacredness of the number twelve and of its multiple twenty-four, on which we have often already commented in connection with the 12 Bhuiyas of Bengal. For other examples not noticed by us before, see H. Yule, *Marco Polo*, London, J. Murray, 1874, I. 417, II. 137, 420.

[2] The king of Portugal.

dellos, aunq′ sea en cosas importantissimas. La renta de S.A. es limitada de manera q′ siempre se le da aquello, ora las tierras rendan mucho ora poco: y si vna aldea se p′dio y no tuuo cosecha, las otras pagan por ella; y si sobra alguna cosa se reparte por los mesmos. El dominio y administracion desta isla es destes hombres q′ se llaman Gancares.[1] El rey tiene el comun senorio y su renta cierta.* Tienẽ en cada aldea todos los officios con sus ordenarios pª lauar ropa, garbear, ferrero, &c.[2]

testifies to what is settled, none of them affixing his signature, even though it be in most important matters[1] His Highness' revenue is limited in such a way that that amount is always given him, whether the lands yield much or little. And if an aldea was lost and had no harvest, the others pay for it; and, if anything remains over, it is divided among the same. The dominion and administration of this island is in the hands of these men, who are called Gancares. The king has the general overlordship and a fixed revenue In each aldea they have all the occupations, and their menials, to wash clothes. to remove refuse,[2] a blacksmith, etc.

Es esta isla muy fresca, saludable y fertil de mantenimientos, caças, fuentes, tanques, &c., mucha diuersidad de fructas y de buena casta en su genero; palmares, arequales, muy frescos, con pimienta y vetre, de q′ ellos vsan y comen todo el dia. Auia en esta islá en t′po q′ era de gen-

This island is very fresh, healthy, and rich in foodstuffs, game, fountains, tanks, etc. There is much variety of fruits, and of good species according to their kinds; there are very fresh palm and arequa gardens, and pepper, and *vetre* (betre, betel) which they use and eat the whole day. There were in this island at the time when it belonged

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[1] Here perhaps: Qancares: elsewhere: Gancares.

[2] Later addition.

[1] For an interesting account of the Island of Salsete, its first Christians and the 'Gancar Chamber,' see Father Francisco de Souza, S.J., *Oriente Conquistado*, 2ª ed., Parte I, Bombaim, 1881, Conq. 1, Div. 2, §§ 55–61.

[2] We should expect our scavengers to be mentioned together with our washermen. Hence, though the Spanish dictionaries translate *garbear* by 'to bind sheaves', I translate as above. See the origin of the English words *garbage*, *garble* in *The Oxford Dictionary*.

tiles 100000 mill vezinos, y tantos todo el t'po q' se les p'mitieron tener pagodes y ceremonias gentilicas.

to gentiles 100000 thousand inhabitants,[1] and there was that number all the time when they were allowed to have their pagodes and gentile ceremonies.

Ay entre estos gentiles muchas castas, mas todas se reducen a tres: Baneanes, Vaissa, Quetri, *Bramenes, Chararos, Chaudaris, Corumbis, Faraces; [1] y estas castas son entre si muy differentes, assi en ceremonias como en

There are many castes among these gentiles; but they are all reducible to three: Baneanes,[2] Vaissa,[3] Quetri.[4] Bramenes, Chararos,[5] Chaudaris,[6] Corumbis,[7] Faraces.[8] And these castes differ much among themselves both in ceremonies,

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Later addition.

[1] Father Monserrate cannot really mean 100,000 thousand, or 100,000,000; but only 100,000. The island of Salsete was only 6 leagues in length and 2 in breadth. Moreover, it had only 66 aldeas or villages, and the population of each of the islands of Choran and Divar, with their more than 30 pagodes each, was only 3000 in 1579. Cf. *infra*.

[2] A Gujaratī plural, '*vāniyān*' (merchants). Cf. Mgr. S. R. Dalgado's *Glossario Luso-Asiatico*, I. 94.

[3] Vaiśya. Cf. Dalgado, II. 117.

[4] Kṣatriya. Cf. Dalgado, II, 235.

[5] Chararo must be akin to Chardo, Charodó, "a person of one of the castes of Christians of Goa." Cf. Dalgado, I. 268. Mgr. Dalgado says that many derivations of the word have been tried without success. Perhaps this new spelling, more than 100 years older than Mgr. Dalgado's earliest example, may help our philologists to clear up the point. On the Charados of the Island of Batim (Goa) and their conversion, see *Oriente Conq.*, *op. cit.*, 2a ed., Parte I, Conq. 1, Div. 2, § 51.

[6] A Chaudarim is a toddy-drawer (Mahr.: *chaudharī*). Cf. Dalgado. I. 268.

[7] A Curumbim is a śudra cultivator (from the Konkanī and Mahrathī *kuṇbī*). Cf. Dalgado, I. 338.

[8] Farraz (Arab.: *farrāsh*): now designates one of the lowest castes of Goa. Cf. Dalgado, I. 390.

costumbres y pagodes. No se comunican entre si ni tienẽ parentesco *ni alguno a de ser mas q' su p^e ni tener otro officio[1]; ni comen vnos con otros. Solam^e en casa de Bramenes pueden comer todos por ser mas honrrados entre los Bramenes (q' es la gente principal, mas branca, y bien proporcionada. ingeniosos y agudos max^e p^a mercadear, q' es su off^o ordinario, y p^a negocios de escriuanos y tratos. y de industria p^a buscar hazienda). Ay dos castas: vnos q' comen carne y pescado. tirando vaca y puerco. Estes son como administradores de todo el Conchan. Ay otros Bramenes. q' se llaman Botos, q' no comen pescado[2] ni carne; y estos, aunq' tienen las mesmas ceremonias, todauia son mas religiosos y recogidos y grandes astrologos. Su officio es predicar y enseñar su ley y hazer todas las ceremonias gentilicas a los otros; y son tenidos de todos los gentiles en grandissima veneracion; grandes enemigos de los X'pianos· y aunq' en el discurso de su vida tienẽ todas las castas diuersas ceremonias,

and customs, and pagodes.[1] They do not communicate with one another or establish relationship by marriage; and no one has to be greater than his father or follow any other profession. They do not eat with one another. Only in the house of Bramenes may all eat, because they are the most honourable The Bramenes form the chief caste: they are the whitest, are well-formed, talented, clever, especially for trafficking, which is their usual occupation, and for the work of scriveners and for commerce, and industrious in making money Among the Bramenes there are two castes: one who eat flesh and fish though not cows' flesh and pork. These are like the administrators of the whole of the Conchan. There are other Bramenes, called Botos[2] who eat neither fish nor flesh and, although these have the same ceremonies, yet they are more religious and more secluded, and great astrologers. Their occupation consists in preaching and teaching their law and performing all the gentile ceremonies for the others: and they are held in the greatest veneration by all the gentiles. They are great enemies of the Christians. And, albeit all the castes have different ceremonies in the course of

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[1] Later addition.

[2] First: pexe

[1] Monserrate generally uses the word pagode for an idol-temple; at times he seems to mean the idol itself.

[2] Boto (Konkanī: *bhat*: Sanskṛt; *bhaṭṭa*): a Hindū priest, a learned Brahmana. Cf. Dalgado, I. 141.

bastara dezir algunas p'prias de los Bramenes

Logo como nasce algun niño Bramene. luego mandan llamar algunos Botos y preguntanle en q' sino y estrella nacio, el successo de su vida. las manhas y costumbres q' a de tener, y todo lo q' responde guardan escrito[1]: y el Boto conforme la estrella le pone nombre: y si acierta de nascer en vna estrella q' llaman mala, echan fuera de casa la creatura o la dan [a cri]ar[2] a otra p'sona, porq' creen q' si quedare en casa q' a de morir su padre y madre. Despues de nascida la creatura, velan sobre ella seis dias continuos por causa de las bruxas: y al .6. dia le hazen ciertas ceremonias a q' llaman sety. dando de comer a muchos, y derraman[3] muchas cosas de comer al rededor de la casa p' los demonios y bruxas. A los .12. dias hazen otras ceremonias. mandando lauar quanto ay en casa, assi ropa como ollas, &c ; y lauan a la creatura y a su madre, y todos se vesten limpiam', y hazen de comer con fuego nueuo, y dizen q' todos los dias atras estuuieron todos empoleados y suzios por parir aquella muger en casa y con aquellas cere-

their life, it will be sufficient to speak of some which are peculiar to the Bramenes.

When a Bramene child is born, they send at once for some Botos and ask him [*sic*] under what sign and star it was born. the vicissitudes of its life, the manners and customs which it must keep, and whatever he answers they keep in writing. And the Boto gives it a name according to its star; and, should it happen to have been born under a star which they call unlucky, they cast the baby outside or give it to another person to bring up: for they believe that, should it remain in the house, his father and mother will die After the birth of the child. they keep watch over it during six full days against the witches, and, on the 6th day, they perform for it certian ceremonies which they call *sety*[1]; on this occasion, they give food to many and scatter many eatable things around the house for the demons and the witches. On the 12th day they perform other ceremonies, causing everything in the house, clothes and pots, etc, to be washed; and they wash the baby and its mother; and all dress neatly, and they cook food with new fire, and say that, all the days before, they were unclean and sullied, because the woman gave birth within the house, and with

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[1] I have hesitated between *ocuto* (? for *oculto*), *secreto*, and *escrito*.

[2] Writing indistinct at the second fold of the page. [3] First: ponen.

[1] Sety. Cf. Dalgado, I. 300. From the Konkanī and Mahrathī, *saṭhī* or *satvī*; Samskṛt *ṣaṣṭhī* (6th day).

monias quedan otra uez limpios, y aquel dia ponen al niño en la cuna con ciertas ceremonias, y le ponen otro nombre, como quiere su padre.

these ceremonies they are again clean and that day they place the child in its cradle with certain ceremonies, and they give it another name at its father's choice.

Como los gentiles desta tierra tengan p^a si q' la alma del hombre despues q' muere se mete en los cuerpos de los animales todos, y vltimam^e en la vaca, y despues torna a otro cuerpo humano, como ellos uiuen en este error, dizen q' quando vn niño Bramen nasce, hasta q' le echan la liña, q' son ciertos hilos, laqual le ponen al .7. año o a los onze años, dizen q' no es Bramen, porq no saben cuya fue aquel alma qn^{do} estuuo en este mundo; y con aquela liña q' le echan por el pescueco y debaxo del braço queda Bramen; laqual no le dan de niño porq', como es cosa de religion, dizen q' a menester vso de razon.

The gentiles of this country hold that the soul of man passes after death into the bodies of all the animals, and lastly into that of the cow, after which it returns to another human body. Holding this error, they say that, when a Bramen child is born, it is not a Bramen until they give it the line (which are certain threads), with which they invest it when it is seven or eleven years old This they say, because they do not know whose was the soul when it was in this world. And with this line, which they put round its neck and under its arm, it becomes a Bramen. They do not give it him, when a child, because, as it is a matter of religion, they say that the use of reason is required.

El modo q' tienen de dar esta liña es este. Primero, preguntan al Boto del dia bueno o malo p^a darsela (porq' en todas sus cosas no hazen nada sin preguntar esto a sus Botos, pagodes, o hechizeros); y sabido del dia, mandan llamar muchos Botos, los quales juntos hazen ciertas ceremonias, haziendo muchas hogueras, al rededor de las quales estan ellos y el niño desnudo y rapado, diziendo sobre el muchas oraciones q' los Botos enseñan, y juntam^e le dan la ley en q' a de uiuer y los mandam^s q' ha de guar-

The manner observed in giving this line is as follows. First, they inquire from the Boto about the lucky or unlucky day in order to give it, because in all their affairs they do nothing without consulting about this their Botos, pagodes, or sorcerers. When they know the day, they call for many Botos, who together make certain ceremonies; they kindle many fires, around which they keep with the child, which is naked and shaven; they recite on it many prayers, which the Botos teach, and jointly they give it the law in which it has

dar, y como a de huir de todas las castas, principalm^{e} de los X'pianos y q' no an de tratar con ellos, y q' an de pedir a N.S q' sola la ley de los Bramenes sea aleuantada y todas las otras sean extinguidas; y con estas palabras le ponen la linha, q' es de tres hilos de hilo branco, al cuello, y otra liña por la cintura a honrra del dios Bramaa, Vistu, y Maessu, q' son su dios, del qual dizen q' vino al mundo en diuersas figuras .7 vezes Enseñanle tambien vna oracion, laqual el de ay adelante a de dezir tres vezes al dia, por la mañana, antes de jantar, y puesto el sol, y cada vez a de dezir aquella oracion ciento y ocho vezes. La liña del cuello no la tiran, ni pueden comer ni beber sin ella La liña de la cinta tiran como acaban de aprender la oracion Esta oracion esta en lenguajen Sansucruta, q' es el lenguajen de los dioses, y cuasi ninguno la entiende; mas lo substancial della es pedir a Dios q' la ley de los X'pianos sea destruida y la de los Bramenes onrrada y aleuantada.

to live, and the commandments which it must observe, and how it must shun all the castes, chiefly that of the Christians, and that they must not have dealings with them, and must ask of Our Lord that the law of the Bramenes may alone flourish and all the others may be extinguished With these words, they put around its neck the line, consisting of three threads of white thread, and another line around its waist, in honour of the god Bramaa Vistu, [1] and Maessu, [2] who are their god, of whom they say that he came seven times to the world in different shapes. They teach the boy also a prayer which thenceforward he must recite three times a day: in the morning, before dinner-time, and at sunset, and each time he must say that prayer one hundred and eight times. They do not take off the line round their neck: they may not eat or drink without it They remove the line of the waist when they finish learning the prayer. This prayer is in the Sansucruto language, [3] the language of the gods, and scarcely anybody understands it; but the chief part of it [the prayer] is to pray to God that the law of the Christians may be destroyed and that of the Bramenes be honoured and extolled.

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[1] Viṣṇu.

[2] Maheśa or Śiva Cf. Dalgado, II 10.

[3] A curious spelling for 'Saṁskṛt.'—The somewhat crude description of the prayer must be a reference to the Gāyatrī.

Quando se casan los Bramenes, se hazen tambien muchas ceremonias q′ se no pueden escreuer. segun son santas La forma de su casamº consiste en poner el marido vn poco de aroz crudo misturado con alegria en la frente de la muger y la muger en la del hombre y con esto quedan casados, y todas las otras ceremonias seruen de ornato, durando las ceremonias por cinco dias en los quales aunq′ duermen en vna cama an de guardar castidad, y si se ajuntan, pierden la casta q′ es cosa entre ellos de grande pena, y q′ les cuesta mucho tornar a resceberlos en ella [*Fol. 152r*] con otras muchas ceremonias. Todas estas ceremonias hazen los Botos por estos cinco dias, dandoles documentos y amonestaciones, y tienen banquetes generales a todos los q′ an de ir, en los quales, por muchas iguerias q′ aja, todas se an de poner delante a cada vno por si, antes q′ comiencen a comer, y puestas, el Boto haze sus ceremonias, y el pᵉ del noiuo, y dan licª pª comer

When the Bramenes marry, many ceremonies are also observed, which cannot be written down, because they are holy. The form [1] of their marriage consists in that the husband puts on the woman's forehead, and the woman on the forehead of the husband, a little raw rice mixed with *alegria.*' [2] Therewith they are married, and all the other ceremonies serve as ornament, the ceremonies lasting five days, during which, although they sleep in the same bed they must keep chastity; and, if they have intercourse, they lose caste and it costs them much and many other ceremonies to be received back into it [*Fol. 152r*] The Botos make all these ceremonies during these five days, giving them many instructions and admonitions; and they hold general banquets for all those who have to take part. In these banquets, all the viands, however many, must be set in front of each one before they begin to eat, and, when all have been served up, the Boto performs his ceremonies, and the father of the bridegroom, and they give leave to eat.

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[1] The word 'form' seems to be used in the theological meaning of 'form' as opposed to 'matter' The 'form' of marriage consists of the words or signs expressing consent and effecting the contract.

[2] (Bot.): the oriental oily-grain (*Sesamum orientale*, L.); paste made of sesamum and honey. Cf. Edw. R. Bentley, *A new dictionary of the Spanish and English Languages*, new ed., Paris, Garnier, (1877?). The words *con alegria* might also mean 'joyfully', but not in our context.

Tambien qn^{do} el Bramen muere se hazen muchas ceremonias Primeram^{e} estando p^{a} morir manda llamar algunos Botos, y delante dellos haze vna confision general de los peccados q' el quiere confessar, y el Boto le da penitencia q' de algunas vacas de limosna * y a de morir con tener la mano en vn rabo de vaca, p^{a} entrar luego su alma en la vaca y en ella ir p^{a} su paraiso [1]; y si tiene algun hijo o hijos con liña, se rapan todos estando a los pies del padre o de la madre; y despues de muerto lauan al muerto en agua fria y amortajanlo en vna sabana nueua, y assi lo lleuan a quemar; y qn^{do} lo van a quemar, el hijo mayor lleua el fuego, y primero q' le ponga fuego, llama tres vezes por el muerto p^{a} ver si esta muerto o uiuo. Acabado de quemar, todos se lauan y hazen de comer con fuego nueuo, y el hijo mas viejo de ay a doze dias a de dormir en el lugar donde murio su p^{e}: y cubrese con vna sabana mojada, y al 12 dia da de comer a muchos Bramanes y otras muchas ceremonias, q' todas van o alimpiarse de q' quedaron suzios en tratar con muertos, o por miedo q' tienen no les venga algun mal por p^{e} del demonio.

Si el q' muere tiene muger, vnas vezes se determina la muger de quemarse con el ;

Also, when a Bramen dies many ceremonies are observed, First, when he is about to die, he calls for some Botos, and makes before them a general confession of the sins which he wishes to confess, and the Boto tells him as a penance to give some cows in alms; and he must die while holding in his hand a cow's tail, in order that his soul may enter the cow and in her go to their paradise. And, if he has a son or sons with the line, all shave themselves, standing at the feet of their father or mother; and, when he is dead, they wash the body with cold water and wrap it in a new sheet; and so they carry it to the pyre; and, when they are about to burn it, the eldest son takes the fire, and, before setting fire to it, he calls three times on the dead person to see whether he is dead or alive. When the body is burnt, all wash themselves and prepare their food with new fire: and for the next 12 days the eldest son must sleep in the place where his father died, and he covers himself with a wet sheet; and on the 12th day he feeds many Bramenes and [performs] many other ceremonies, all of which tend to purifying oneself of the uncleanness contracted by touching dead persons and for fear that the demon should bring any evil upon them.

If the dying person has a wife, she at times decides to burn herself with him; at other times not when she has many children. When she otras no, qn^{do} tiene muchos hijos Qn^{do} se determina de quemarse con el juntam^{e}. tanto q' muere el marido. luego se vnta de azeite q' es señal q' quiere morir, y dize mill palabras amorosas hablando con su marido, relatando los bienes q' le hizo en su vida, los gustos y pasatiempos q' tuuo con el, y dize le q', pues assi es, q' no lo a de dexar ir solo a la otra vida, sino q'lo a de acompanhar. Y assi hazen vn grande poço con grande fuego, y con muchas fiestas y canciones de sus pagodes se a de venir a echar en el fuego, vestida y arreado [*sic*] de todo [*sic*] la riqueça y joias q' pudiere auer. Come todo aquel dia *vetre*, q' es cosa q' embobeda, y a todos quantos la acompañan, antes q' se lance en el fuego, les da a comer *vetre* Como ella se echa en la foguera, o la echan algunos deuotos y honrrados parientes, q' tienen esto por grande onrra, cargan sobre ella infinito azeite. p^{a} q' se queme mas presto, porq' el arepentirse ya no esta en su mano, por el poço ser hondo, y acudir le con azeite, y aun con quantidad de piedras,* y con palos grandes tienen mano en ella [1] ; y despues le hazen vna pared de piedra p^{a} memoria de la q' alli se quemo ;* y despues de .3. dias quemada, toman su cemca, y la guardan p^{a} por los joges embiarla a

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[1] Later addition.

resolves to burn herself together with him, at once, at the death of her husband, she anoints herself with oil, which is the sign that she wishes to die ; and she says a thousand loving things talking to her husband, recounting the good things she did for him when alive, and the pleasures and amusements she had with him ; and she says that accordingly she must not let him go alone to the next life, but must accompany him. And so. they make a big pit with a great fire ; and, amid many rejoicings and songs in honour of their pagodes, she must come and throw herself into the fire, clothed and decked out in all the wealth and jewels she may have. The whole of that day she eats *vetre* [betel], something which stupefies ; and, before throwing herself into the fire she gives to all those who accompany her *vetre* to eat. While she throws herself into the fire, or some devout and upright relatives cast her in, considering this a great honour, they pour upon her any amount of oil, so that she may burn the quicker : it is too late for her now to repent, for the pit is deep, and the people help with oil and even with heaps of stones, and they keep her down with big poles. And afterwards they erect a wall of stones in honour of her who burnt herself there. And, three days after the burning, they take her ashes and keep them to send by the joges [1] to

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[1] Later addition.

[1] Jogis.

echar en el rio Ganges. como trazen cada año a todas las cencas de los quemados, por ser la romeria a este rio de grande deuocion.[1]

Quando se va a quemar leua en la maño vn limon o vn peine y dize q′, p^a q′ vea[2] q′ va a gozar de la otra vida, q′ despues de muerta y quemada hallaron el limon fresco y el peine enteiro. Y es cierto, segun dizen, q′ el demonio muchas vezes vsa deste engano p^a as leuar al infierno mas de presa.

Si la muger es vieja y tiene hijos[3] y no se quiere quemar, va se a los pies de su marido muerto. y alli se rapa, y se despoja de todas sus joias p^a nunca mas gozar de cosa de pasat′po deste mundo. Si solam^e eran desposados. quedando ella donzella, a se luego de rapar, y no a de vestir mas paño lauado ni poner joia en su cuerpo, y siempre a de ser viuda y no a de ir a fiestas ningunas ni ver regozijos.

Son todos estos gentiles dados a supersticiones y agueros. Tienẽ grande veneracion a las culebras de capelo, y a estas pintan en sus pagodes. Nada an de comencar sin respuesta del ministro del pago-

the Ganges and throw them into the river: indeed. every year they carry to the Ganges the ashes of all burnt corpses the pilgrimage to that river being one of great devotion.

When the wife goes to burn herself. she carries in her hand a lemon or a comb, and she says that. in order that they may see that she goes to enjoy the next life, they will, after she is dead and burnt find the lemon fresh and the comb entire. And it is certain, according to what they say that the devil many times uses this trick to take them [these women] to hell the sooner.

If the woman is old and has children and does not wish to burn herself she goes to the feet of her dead husband. shaves herself there, and divests herself of all her jewels. never again to enjoy any of this world's amusements. If they were only betrothed the girl. who must remain unmarried. shaves herself. and she must never again wear washed clothes or put on jewels; she must for ever remain a widow. and may not go to any festivities or witness rejoicings.

All these gentiles are much given to superstitions and omens They have much veneration for the hooded snakes[1] and depict them in their pagodes. They must begin nothing without an answer from the minister of the pago-

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[1] Later addition.

[2] Vean (?)

[3] First: filhos

[1] Cobra de capello, Naja tripudians.

de, p^{a} loqual lleuan vnas rosas, y mojadas peganlas al pagode, y estan postrados y muy deuotos esperando su ventura, porq' si caen prim^{o} las del lado derecho, tienen por cierto q' todo les sucedera bien ; y si caen primero las del isquierdo, no ponen mano en ninguna cosa ; y lo mismo si, qn^{do} salen de casa, les grazna alguna graja, o si algun perro ladro a su puerta, o si cayo algun gusano en su cabeca, &c. ; y p^{a} q' el pagode les quiera responder offrencele gallos muertos, cocos, arroz, cabrones, carneros ; y todo esto es p^{a} los jogis q' son ministros de los pagodes. *Offrecianle cada dia vnas alparcas s. sandalia, porq' dezian q' toda la noche andaua peleando con los otros dioses por defender su pueblo [ten]iendo el vna piedra tan grande q' 20 hombres no lo leuãtarian.[1] Y esto mismo hazen al tpo de sembrar, y la sangre destos animales, como cosa sancta, lancan la en los valados de sus heredades q' estan junto de la mar, porq' cuydan q', qn^{do} el mar anda leuantado, es la ira de dios q' gouierna aquella parte.

de ; for this they bring some roses, and, after wetting them, stick them to the pagode, and they lie prostrate and very devout, waiting for their luck ; for if those of the right side fall first, they consider it certain that all will go well with them ; and if those of the left fall first, they undertake nothing.[1] The same when, going out of doors, they hear the croaking of a crow, or a dog barked at the door, or a worm fell on their head, etc. And, in order that the pagode be willing to answer them, they offer to it dead fowls, coconuts, rice, he-goats, and sheep, and all this is for the jogis, who are the ministers of the pagodes. They offered every day to him [the pagode] certain slippers, i.e., sandals, because they said that the whole night he went about fighting the other gods to protect his people, holding a stone so big that 20 men would not be able to lift it. The same they do at the time of sowing, and they sprinkle the blood of these animals, as something holy, in the enclosures of their fields which are near the sea, because they think that, when the sea is stormy, it is the anger of god, who rules that part

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* Later addition.

[1] Mgr. Dalgado has the following in this connection (I. 141): 1890.—" O bhoto molhou as flores, collocou las em linha, e revelou que se cahisse primeiro a segunda flor da terceira columna a alevantina era a mulher de Vichnu."—Antonio de Almeida Azevedo, *As Communidades de Goa*, p. 33.

Eran mucho dados a pagodes, y cada casta tiene sus distinctos pagodes, tanto q' auia en esta isla .360., y cada vno con su renda distincta, q' se gastaua el dia de su fiesta, y en los ministros q' seruian al pagode, y en las mugeres publicas y bailaderas q' continuauan en el pagode pª todas sus immundicias. Tinhan dioses de la guerra, de la sementera, de la fortuna, de la vida, de la muerte, y sobre todos del dios diablo, q' a este hazen mas seruicios y reuerencia, y assi lo llaman y por tal lo inuocan, porq' es temido, y es gente mucho subiecta al miedo y al interes, q' piensan q' les a de quemar los arrozes y destruir los palmares, &c. ; y assi le hazen iglesias en la figura q' les aparece, q' es vna compasion ver quan grande dominio y gran duro Jugo tiene puesto el demonio aquellas almas. Tienen tambiẽ por diosas a mugeres q' fueron malas y por tales tenidas, *porq' al fin se mandaron sacrificar en onrra de los pagodes[1]; y en los pagodes destas, al rededor dellos, se dedican muchas mugeres pªq' vsen dellas quantos quisieren. *Y auia pagode de mill esclauos y de 500. mugeres publicas, y si vna muger peleaua con su marido, si se recogia al pagode por publica, no podia cobrar la mas.[2]

They were much given to pagodes, and each caste has its separate pagodes, so much so that there were 360 in this island, each with its separate revenues, which were spent on the day of its feast, and on the ministers serving the pagode, and on the public women and danceresses who lived in the pagode for all their impurities. They had gods of war, of the sowing season, of fortune, of life, of death. and above all the devil-god, whom they serve and reverence most, and they call him so and invoke him as such, for he is feared, and they are people who are much swayed by fear and interest. and they think that he will burn their rice and destroy their palm-groves, etc., and so they build churches for him and represent him in the shape in which he appears to them. Indeed, it is a great pity to see how great a dominion the demon has over those souls and how heavy is the yoke he lays on them. They also regard as goddesses women who were bad or considered as such, because after all they had themselves sacrificed in honour of the pagodes ; and, in the pagodes of these goddesses, all around them [the pagodes], many women dedicate themselves to be used by as many as like. And there was a pagode of one thousand slaves and 500 public women ; and, when any woman fought with her husband, he could not recover her, if she retired to the pagode as a prostitute

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[1] Later addition.

[2] Later addition.

Ay en esta isla .6 iglesias, en las quales todas residian p^{es} de la Comp^{a} occupandose en la conuersion de tanta gentilidad, y auia ya cerca de 10000 X'paos y mill cathecumenos; mas con la guerra q' vbo en Goa con el Hydalcan el año de 71 y con la q' agora vbo por causa de Dabul y del alcuantam^{o} de los gentiles, por no querer concederles pagodes y ceremonias q' el Visorey Don Ant^{o} el ano de 66. mando derriuar y applicar las rentas a las iglesias, y el Concilio primero p'uincial de Goa asento q' se les quitasẽ todas las ceremonias de sus casamientos y vnturas de sandalo. padescio algun detrim^{to} la X'piandad y no se pudo paſsar adelante con la conuersion: mas todos los X'pianos se retiraron p^{a} Goa y sus aldeas, en q' dieron mucha edificacion de si, dexando su tierra y hazienda y parientes por guardar y conseruar la fee.

. . . .

There are in this island 6 Churches, in all of which there resided Fathers of the Company, who laboured for the conversion of so vast a gentility; and there were already about 10.000 Christians and one thousand catechumens; but, owing to the war which there was with the Hydalcan in the year [15]71, and on account of the one waging now because of Dabul and the rebellion of the gentiles—for they would not grant them pagodes and ceremonies, Viceroy Don Antonio[1] having ordered to destroy them in the year [15]66 and to apply the revenues thereof to the Churches, and the first Provincial Council of Goa[2] agreed that they should be forbidden all the ceremonies of their marriages and their anointing themselves with sandal—the Christianity suffered some detriment, and it was impossible to proceed with the work of conversion; but all the Christians withdrew to Goa and its aldeas, wherein they gave much edification abandoning their country and property and relatives in order to keep and preserve their faith.

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[1] Don Antonio de Noronha, 9th Viceroy: left Lisbon, March 29, 1564: governed 4 years and 2 months, until October 1568; returned to the kingdom. Cf. Padre Manoel Xavier, S.J., *Compendio universal de todos os Viso-Reys, Governadores,...*, Goa, Imprensa Nacional, 1917, p. 68.

[2] The first Provincial Council of Goa sat in 1567.

[*Fol. 152v.*]

JHS.

Informacion de la Isla de Choran y la Isla de Diuar.

Estas son dos islas pequenas q′ estan junto de Goa a la p^{e} del norte, y no las diuide mas q′ vn rio. Destas no ay mas q′ dezir q′ lo q′ se dixo de Salsete: por la gente, modo de uiuir. castas, officiales, gouierno, pagodes, ceremonias, dioses, son todos vnos, aunq′ siempre se differencias [*sic*] en algunas cosas de poca importancia; solam^{e} q′ assi como Salsete se gouierna por aquellos 24 de 12 aldeas, cada vna destas por diez Bramenes Gancares. Aura en cada vna tres mill almas; y auia en cada vna dellas mas de 30 pagodes con mucha renda. Agora ya no ay pagode ninguno en pie, sino, iglesias:* y todos son X′pianos por industria y zello del Visorev Don Constantino[1]; y la escuela de la doctrina en cada vna tiene mas de 400. niños, q′ an de ser muy buenos X′pianos. Son administrados y ensenados solam^{e} por los p^{es} * de la Co^{a}.[2]

[*Fol. 152v.*]

JESUS.

Information about the Island of Choran and the Island of Divar.

There are two small Islands near Goa, on the north side, and they are separated only by a river. There is nothing to be said about them except what we said about Salsete: for the people, the manner of life, the castes, the occupations, the government, pagodes, ceremonies, gods, are all the same, although there are always differences in some matters of little importance: only that, whereas Salsete is governed by the 24 from the 12 aldeas, each one of these[1] [is governed] by ten Gancares, Bramenes. There must be in each of them three thousand souls. And there were in each more than 30 pagodes, with much revenue. Now there is not one pagode standing, but Churches; and they are all Christians, thanks to the diligence and zeal of Viceroy Don Constantino[2], and the school of the doctrine[3] in each of them contains more than 400 children, who will turn out very good Christians. They are ministered to and taught solely by the Fathers of the Company.[4]

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[1] Later addition.

[2] Later addition; difficult to decipher.

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[1] Of these two islands.

[2] Don Constantino de Bragança, 7th Viceroy: left Lisbon, April 7, 1558; governed 3 years and 8 days, Cf. Padre Manoel Xavier, S.J., *op. cit.*, p. 68.

[3] Of the Christian Doctrine or Catechism.

[4] On the conversion of the people

Y en estas dos islas tiene la Compª alguna renda q′ el rey les dio pª su sustentacion, y a esta causa son mas quietos porq′ no tienen q′ andar con officiales de justª en sus pagam^{os}, &c.

Entre los pagodes q′ tenian era vno,* llamado Saptanato,[1] muy senalado y frequentado el dia de su fiesta, q′ era en la luna de Agosto, y concurrir muchos peregrinos de toda manera de gente, y la causa era q′ aquel dia echauan en el rio, q′ estaua junto al pagode, en cierta parte del rio donde haze................,[2] vetre y fructas, lasquales el agua sor[ba] pª dentro con la fuerca del agua, q′ entonces es mayor por ser inuerno, y ellos pensauan q′ venia alli el demonio a rescebir aquella fructa, y por este recebimº le hazian grande fiesta, y le offrescian grandes dones: y muchos, enamorados del demonio, lo querian ir a ver, y se echauan en la fuerca del agua y desapareciã luego; y los demas pensauã q′ iba

And in these two islands the Company has some revenues which the king gave them for their maintenance, and for this reason they [the Fathers] are more quiet, since they have not to depend on the officers of Justice for their payments, etc.

Among the pagodes which they had, there was a very famous one, called Saptanato [1]; it was frequented on the day of its feast, which fell in the moon of August, by the concourse of many pilgrims of all manner of people; and the reason was that on that day they threw into the river, which is near the pagode where [it] makes...... *vetre*, and fruits, which the river swallowed up owing to the force of the water, which is greater then as it is winter, and, to celebrate this acceptance, they made great festivity in his honour, and offered to him great presents And many of them, enamoured with the demon, wished to go and see him, and they cast themselves into the force of the water and disappeared immediately, and the rest thought that they

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[1] Later addition.

[2] Some 2 or 3 words illegible at the first fold of the paper.

of Chorão by the Jesuit Fathers. see *Oriente Conquistado*, *op. cit.*, 2ª ed., Parte I, Conq. 1, Div 2, §§ 40, 41, 42. On the conversion of the people of Divar, see *ibid.*, Parte I, Conq. 1, Div. 2, § 50.

[1] Father Monserrate refers to this Saptanato and other Hindū places ending in *nāth* in his *Mong. Legat. Comment.* See p. 598. Compare also *ibid.* what he says about *sati* (p 374), and about Kṛisna's nine *avataras* (p. 587).

derecho al paraiso. Y como, con la venida de los Portugueses y padres, les quemasen todos sus pagodes, por ser este nombrado en la otra vanda del rio, q′ es tierra de Moros *le [1] hizieron los gentiles otra casa,* y lleuaron las reliquias q′ pudieron,[2] y le hazen la misma fiesta. y tienen sus lauatorios, &c.

Van se todos los X′pianos destas dos islas acomodando mucho en todas las cosas, como los X′pianos viejos, en acudir a la iglesia, predicacion, confession, comunion, enterram^{os}, casam^{os}, baptismos, con mucha fiesta y deuocion: y ayudan muy bien a el estado de la India en la guerra, porq′ los de Salsete sustentaron mucho t′po en pie su tierra contra los aleuantados; y los de Choran en t′po de la guerra de 71 se defendieron y mataron muchos Moros q′ entraron en la isla; y agora ellos solos sin Portugueses difienden su tierra

went straight to paradise.[1] And since, at the arrival of the Portuguese and of the Fathers, all their pagodes were burnt, this [pagode] being situated on the other side of the river, which belongs to Moors, the gentiles rebuilt for him another house [? for themselves other houses] and took what relics they could, and they celebrate the same feast in his honour and have their baths, etc.

All the Christians of these two islands conform religiously to all the things of the faith like the old Christians, such as coming to Church, sermons, confession, communion, burials, marriages, and baptisms [which they celebrate] with much rejoicing and devotion; and they are of great assistance to the Estado of India in time of war; for those of Salsete defended their country for a long time against the rebels, and those of Choran, during the war of [15]71, defended themselves and killed many Moors who came into their island, and now they alone, without the Portuguese, defend their

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[1] Perhaps; *ce* for *se*.

[2] Later addition.

[1] See *Oriente Conq.*, *op. cit.*, 2^{a} ed., Parte I, Conq. 1, Div. 2, § 50, about a great pilgrimage in the Island of Divar. "Divar was as venerated by the gentio Bramanes as among us the Holy Land, on account of a pagode of great indulgences and pilgrimages, and even now [1697], on a certain day of the year, the whole gentility of the neighbourhood flocks thither to bathe on the bank of the river, opposite the place where of old was the pagode, lest they should lose this plenary indulgence."

de los Moros, y hazen asaltos con animo en tierra firme, y les van a su tierra a quemar y destruir los pagodes, q' por esta causa se an metido los Mouros por la tierra adentro; y el * G.[1] Don Diº de Meneses les mando dar cabajas vermejas en senal de su esfuerço; y si los X'pianos fuesen fauorecidos y honrrados..........[2] dignidades y cargos polos Visoreyes, fidalgos y officiales como S. A. manda; cresceria mucho la X'piandad, y S. A. seria mas seruido y sus tierras seguras, y breuemᵉ toda la gentilidad reducida, con q' esta mucho mas segura y rica la India.

country against the Moors, and they attack bravely on the mainland and go to their territory to burn and destroy the pagodes, so much so that on that account the Moors have retired inland: and Governor (?) Don Diogo de Meneses[1] ordered red *cabajas* to be given them in token of their bravery; and, if the Christians were favoured and honoured....with dignities and offices by the Viceroys, fidalgos, and officers, as His Highness commands, the Christianity would greatly increase, and His Highness would be better served, and his lands would be more secure; and the whole gentility would be converted in a short time, with the result that India is safer and richer

Informacion de las Malucas.

Las Malucas son infinitas islas; entre ellas grandes de 300 *y trinta[3] leguas como Morotai; y de 150, como Morotia, y otras pequenas de .4., como Ternate, y 20. como Amboino, Tidor, Oliazer, Nuzelao, Athua, Ouma, Abouro. Nombro estas porq' en to-

Information about the Malucas.

The Malucas consist of an infinite number of islands. Among them some are 300 (and thirty ?) leagues big, as Morotai, and 150, as Morotia; others are small, 4 leagues in extent, as Ternate; and 20 as Amboino, Tidor, Oliazer, Nuzelaõ, Athua, Ouma, and Abouro.[2] I name these, be-

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[1] A doubtful letter; probably *G.* for *Gobernador.*

[2] 2 or 3 words illegible at the 2nd fold of the paper.

[3] *Y trinta* appears to be effaced.

[1] Don Diogo de Menezes, 6th Governor: governed 9 months (21 Nov., 1577–22 Aug., 1578). Cf. Padre Manoel Xavier, S.J., *op. cit.*, p 69.

[2] On Oma and Athua, see *Oriente Conquistado*, 2ª ed., Parte II, Conq. 3, Div. 1, § 7. The whole of that Conquista 3 is devoted to the Mission of the Molucas. I do not

das estas auia X'piandad, sin otras muchas q' no estan descubiertas ni tienen noticia de n'ra sª fee. Auria en todas estas islas mas de 70000 X'pianos, y con las guerras q' entre si con los Mouros tuuieron todo esta quasi destruido, y los X'pianos se tornaron Moros, saluo en Amboino, adonde ay algunos Portugueses y algunos p^{es} de los n'ros, y aura 20000 X'paõs.

cause there was Christianity in all these, not counting many others which are not discovered and have no knowledge of our holy faith. In all these islands there must have been more than 70,000 Christians; and, on account of the wars they had among themselves with the Moors, almost the whole is destroyed, and the Christians became Moors, except in Amboino; where there are some Portuguese and some Fathers of ours, and there must be 20,000 Christians.

Endorsement (Fol. 152 r); A Do.[1]

Jhs. Informaciones de algunas X'piandad s de la India Para ver n'ro P.G.

[*The End.*]

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find there the three other islands Oliazer, Nuzelão, Abouro; but I trust that I have read the names correctly I have a doubt about Oliazer, which may perhaps be read as Dhazer.

[1] These letters on two different lines seem to indicate that Monserrate was going to write the address but left it unwritten. *A* would mean: *to*; *Do* would mean *from the*; perhaps, ' do Padre Ant° Monserrate ' was to come there.

25. Father A. Monserrate, S.J and Capt. F. Wilford.

A note by THE REV. H. HOSTEN, S.J.

In *Asiatick Researches*, Vol. IX (Calcutta, 1807), among the errata and addenda, I find that the following passage, which should have been added to p. 81, line 18, i.e. at the end of Wilford's essay on *Anu Gangam, or the Gangetic Provinces, and more particularly of Magadha*, contains a reference to Monserrate which I overlooked in my edition of Monserrate's *Mongolicae Legationis Commentarius* (*Memoirs A.S.B.*, Vol. III. No. 9). It should have been inserted there at p. 695, after my fifth quotation from Wilford's writings.

The new passage runs thus:—

"The Magas in Bengal are mentioned by Pliny under the name of Macca-Calingas. It appears from the context that the upper part of the Bay of Bengal was divided into three parts, called in general Calinga, or the sea-shore in Sanscrit, from its abounding with creeks. West Calinga extended from the river of Cuttaca[1] to the western mouth of the Ganges.[2] In an island of the Ganges, *amplae magnitudinis*, of very great magnitude, and of course the Delta, was a single nation called Modo-Galica and Modo-Galenca, from the Sanscrit Madhya-Calinga, or middle Calinga: then came the Macco-Calingas, or the Magas of Chittigong,[3] from Maga-Calinga. The Magas or Mugs maintained themselves as an independent tribe in the Delta for a long time; and they were at last expelled by the Musulmans and the Rajas of Tipera, about the beginning of the sixteenth century, as mentioned by P. Monserrat. Through the Burman Empire, Arracan and in Chittigong the Priests only are called Magas according to Col. Symes · but in Chittigong and adjacent countries, the name of Muga is also attributed to the whole tribe."

Wilford adds the following note to Fr. Monserrate's name:

"'Gens vero Modo-Galica, ii qui vulgo dicuntur Mogi, quamvis nostrâ memoriâ a Patanicis et Tybreris ultra Balsaris rivumpulsi Arracani consistunt.' P. Monserrat *de legatione Monqolica*, vol. the 1st, p 19., a manuscript in my possession."

I had noticed in my edition of Monserrate's *Mongolicae Legationis Commentarius* (*op. cit.*, p. 699) another passage in which Wilford quoted Monserrate in connection with Arakan (see *Asiatick Researches*, vol XIV, 1822, p. 454; Article: *On the Ancient Geography of India*). There Wilford said in note about the book of Monserrate which he quoted: "In an autograph MS of the author in my possession. The Padre wrote about the year 1590, in the prison of Senna in Arabia." And I had to remark, what I have to remark also on the new passage quoted above, that there is no parallel passage in the MS. of *Mongolicae Legationis Commentarius* which I have edited. Wilford said again (*Asiatick Researches*, IX, 1807, p. 230 *n.* 1): "The original MSS. of Monserrate's travels is in my possession," where the singular verb seemed to-show that by 'MSS.' he meant 'MS.'

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[1] Cuttack. [2] The Hugli. [3] *Sic.*

In the new passage now found Wilford gives the title of the book as *De legatione Mongolica.* It is the only time that he does so He adds that the passage he quotes is in the first volume of Monserrate's work. This shows that he had at least two volumes of Monserrate's in his possession, both of which seem to have been entitled *De legatione Mongolica.*

Now, in his preface to the MS. edited by me, Monserrate refers to four volumes written by himself. One volume contained the history of the first Jesuit Mission to Akbar's Court; another had developed from a small treatise into a regular book on the geography and natural history of India Similarly he wrote a volume on his captivity, and that of his companion Father Peter Paes, in Arabia, and another on the geography and natural history of Arabia Cf *Mem. A.S B*, *op cit*, p. 536 and p 536 *n* 5. Wilford quotes nowhere Monserrate's two MSS on Arabia. These two MSS. remain yet to be discovered. Neither can I find in Wilford's many quotations from Monserrate on India and Akbar that he had in his possession the very MS. which I published. Rather the contrary The passages which he quotes either are not textually those which I published, or they are not to be found at all in my MS. Only once does Wilford give the pagination of one of his quotations (cf. *Asiatick Researches*, IX, 213), and then too the page of his MS (p. 164) does not tally with the pagination of the MS. which I used.

What autograph MS of Monserrate's, entitled *De Legatione Mongolica* and consisting of two volumes, could Wilford have had? Of the MS used by me Monserrate said at the end that it was fair-written in prison at Senaa in Arabia in 1590, between October 21 and December 11 Yet, it too became eventually a sort of rough copy, owing to the many erasures, emendations, and additions thrown in at a later date, even after his return to India, i.e. between 1596, when he was ransomed from captivity, and 1600, the year of his death He certainly intended to recopy it in another form. Whether he did so I cannot say. Anyhow, the volume which I used would not have given him materials for two volumes. The geographical notes in Wilford's first MS. volume had already been omitted from my MS. and cast into a separate volume It follows that Wilford's two volumes represent an earlier redaction, in which the history of the Mission was mixed up with notes on the geography and natural history of India.

That being so, Wilford's two volumes are apparently the work of which Monserrate says in the MS. which I edited. "I completed this Commentary at Eynan in Arabia on the feast of St. Anthony of Padua, in the month of June of the year 1590," i.e. June 13, 1590. That MS. was taken from him by the Turks, but was restored to him at Senaa on the feast of the Eleven Thousand Virgins, 1590, i.e. October 21. Cf. *Memoirs A.S.B*, *op cit*, p. 676. His fair copy, finished on December 11, 1590, must have been made from it. That earlier copy was naturally the rough draught which, on his being sent to Ethiopia in 1588, followed him from India to Arabia. A summary of the diary which he kept most faithfully from his departure to the Moghul Court (1579) up to his return to Goa in 1582, it now seems from Wilford's new quotation that it comprised two volumes in which the history of the Mission was interspersed with disquisitions on Indian geography and natural history

Wilford must have had at his disposal a magnificent library. containing even a fine collection of theological books. I find him quoting Cardinal Bellarmine and Cornelius a Lapide (*As. Researches.* XI, 61), which is not a little surprising for such a place as Benares. where he resided from 1788 to 1822 the year of his death. Where had he obtained his marvellous library from, including scarce Jesuit MSS, and rare old Latin and Greek books on travels and geography?

After I had edited *Mongolicae Legationis Commentarius*, the Rev. W. K. Firminger, who had discovered the MS. in the St. Paul's Cathedral Library. Calcutta. suggested in *Bengal: Past & Present* that, as the library mark of the MS. appeared to be of the same kind as those of a number of theological books in the St. Paul's Cathedral Library, all these books must have come to Calcutta on the same occasion Now, we know that the Monserrate MS. in the St. Paul's Cathedral Library passed from Lord Wellesley's Collection (?), Fort William, to the Metcalfe Hall Collection, whence it went to the Imperial Library, Calcutta, and from there to the St. Paul's Cathedral Library.

To clear up this point. I paid a visit to St. Paul's Cathedral on February 1, 1922, and inspected, with the help of a MS. catalogue made by the Rev. W. K. Firminger, a certain number of books of Catholic theology which had come from Fort William College. I found library marks of the type of XVI. L. 127. in the Monserrate MS., a Metcalfe Hall mark, but none of the same type as I.P 46. There was no indication either that any of these books had belonged to Wilford or had come from the Jesuit College of Agra or of Goa. I found no other MS. of Monserrate's and the *Mongolicae Legationis Commen-*

tarius MS., which I have edited, was not entered in the new type-written catalogue.

To return to the new quotation from Monserrate which we have discovered in Wilford, I believe that Wilford is correct in identifying Monserrate's Tybreri or Tybrerae with the people of Tippera. I do not know, however, what river corresponds to the river of Balsar. If Wilford is right in identifying Modo-Galica or Modo-Galenca with Madhya-Kalinga or the Middle Kalinga, the derivation of Cock Island, or Cock's Island, Coxe Island, now merged with Dog's Island into Saugor Island at the mouth of the Hugli, would be thrown a great deal further back than Ilha de Gale, Ilha de Gallo, Ilha de Galinha. In his map (*Mem. A.S.B.*, Vol. III, No 9, at the end) Father Monserrate calls it *Gallorum Insula*, which would indeed correspond to Cock's Island, whereas Ilha de Galinha would mean Hen's Island. Ilha de Galinha would, however, have been a corruption natural to the Portuguese for an island inhabited by the Modo-Galica or Modo-Galenca. And so, the derivation sought by Sir R. C. Temple (Cf. *Thomas Bowrey's Geographical Account of Countries round the Bay of Bengal*, 1669-1679, p. 210 *n.*) in *Gallinhas del Mar*,[1] a sobriquet for the timorous mixed offspring of the Portuguese in India, would appear far-fetched Besides, the sobriquet must be later in date than the first Portuguese name for Cock's Island.

Goethal's Indian Library,
St Xavier's College, Calcutta.
January 27, 1922.

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[1] *Del* is not the usual possessive case of the definite article in Portuguese.

26. An Old Gypsy-Darwish Jargon.

By W. Ivanow.

In my previous papers on the language of the Persian gypsies[1] I mentioned the fact that many idioms, which may be regarded as nowadays quite indispensable to the vocabulary of the gypsy patois in Persia, are frequently met with in the jargonic codes used by wandering darwishes, some classes of craftsmen, and especially by thieves, professional beggars, etc., in that country. The composition of these jargons, as already shown by me (J.A.S B., 1920, p. 284), is invariably synthetic The bulk of such patois consists usually of the local dialect of the majority of the population in the province or district to which the particular gypsy community confines its wanderings. This original dialect, Persian, Turkish, Kurdish, etc, as the case may be, in its most vulgar form, is invariably freely 'gypsified.' The chief devices used for this purpose are the addition of various suffixes (of which a number were given in my previous papers), transposition of syllables, etc Besides, there are always found various terms of different origin, which are used by gypsies all over the country, i.e. (1) Persian or Arabic words employed in some uncommon conventional sense; (2) idioms which often sound more or less Indian, and (3) accidental expressions picked up from different languages, as well as a considerable number of words which do not yield to etymological analysis Most probably the words in this last category are simply the product of irregular and accidental modifications, 'wear and tear' in a linguistic sense, or cases of reiterated 'gypsification'

As far as I could collect information in various corners of Persia, it would seem that practically all these elements, in varying proportions, however, are found in the darwish jargon. It is remarkable that while artificial formations are often chosen for expressing abstract ideas, the most common and elementary conceptions are usually expressed in terms borrowed exactly from that enigmatic group of etymologically untraceable words just mentioned. It is also remarkable that even amongst the old and well-known Sufic terms, there are many which likewise are puzzles from the etymological point of view So, for instance, is the word *darwīsh* itself, and many others, such as *abdāl* (a very old word), *qalandar* (introduced about the time of the Mongol invasion), *kashkūl* (comparatively new), etc ideas cannot be reconstructed. Something is said about 'the language of those who call 'Alī a God' (زبان علی الله خوانان) Further there are a few words about *Ṭufayliyān* (parasites, uninvited guests); also about Sufis, and even Jews (جهودان *sic*, the form used in Turkestan).

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[1] *Journ. Asiat. Soc. Beng.* (n.s.) X, pp. 439–455 (1914) and XVI, pp. 281-291 (1920).

The vocabulary which follows this is arranged probably under subjects. But the principle of classification was not followed strictly. The part of the vocabulary which still exists, contains some 400 expressions, but only about one hundred of them are legible.

The general nature of the vocabulary suggests that: (1) it was intended to be perused in a country with a non-Arabic speaking population; (2) the community which perused it was an organisation with pronounced religious or Sufic interests; and (3) judging from the equivalents for proper names, was strictly Shi'itic in its tendencies.

Two names casually found may be of some use in future research as to the identity of the community. They are: Abū-Sa'd (or Abū Sa'īd) with the code-surname '*ishq* ('love'), and Abū'l-Qāsim (*Khalīfa*, 'the lieutenant,' a term still much used by Persian darwishes and sectarians, who apply it to one of the various degrees of priests taking part in their secret rites).

The selection of such seemingly unsuitable matters for a collection of treatises which could appeal only to the most educated and intellectual men of the time, may most probably be explained by its utility for controversial purposes.

THE VOCABULARY.

The groups into which the vocabulary may be dissected are mentioned in the beginning of this paper and need not be repeated. As it is impossible to arrive at a precise conclusion as to the real pronunciation of the words given in the list, I will leave them as they are in the Arabic character, adding only their meaning in English and such references as are necessary.

Very few generalisations can be suggested on examination of the philological structure of the code. The suffixes used for modifications of words of familiar origin are the same as those nowadays in common use amongst Darwishes and Gypsies,—i.e. chiefly *-ā*, *-ī*, and the Persian diminutive suffixes *-ak* and *-cha*. There is a prefix of an obscure nature, *b-r* or *p-r* (بر), which seems to be used equally for privative as well as for possessive formations.

The ordinary Gypsy and Darwish device of to-day of using an Arabic word for a simple and common idea which is ordinarily expressed by a Persian term, is very frequent here.

The same can be said of the cases of transposition of syllables, especially in connection with the liquida.

Note.—The following abbreviations are used in the list: A. for Arabic; G.—Gypsy G.I.—my paper in J.A.S.B., 1914, pp. 439–455; G. II another, *ibid.*, 1920, pp. 281-291; met.—metaphorical; P.—Persian; pr.—prefix; sf.—suffix; T.—Turkish; D.—used nowadays in the jargon of the Darwishes of Persia; lit.—literally.

(*a*) *Words still used by the gypsies in Persia.*

نیک - دخ good. This word, now sounding *dakh*, is a most common gypsy and darwish jargonic term (cf. G. I, 449, G. II, 287). In the darwish speech it forms compound verbs with the help of کردن.

ریش - (?) دکنی beard. Obviously connected with G. *dagnā* (G. I, 250), which is a 'general name' (substantive as well as adjective) for everything connected with the mouth —the mouth itself, the lips, teeth, beard, etc.

زن - دنه woman, wife. Now one of the most common G. words (cf. G. I, 450), with its equivalent *jewit*. It is pronounced with the addition of occasional suffixes, and sometimes with a transposition of syllables: *danä* or *dänäw* (East Persia); *dinki* (Jīrūft, apparently with a diminutive sf.); *nidu* (or *nidäw* .;, with transposition of syllables (Sīrjān); *nidéo* (Southern Khorasan),[1] *nodo* (Lōṛī, Baluchistan Gypsy),[2] etc.

بسر - ساونه son, boy. Cf. G. I, 454, *sīná* used in Qāīn

نماز - صلاته prayer. (A.). Among present day gypsies it is used for everything connected with religion.

سک - کلبا dog. (A.). Nowadays commonly used by darwishes: the gypsies use it also in the form of *kalpik* (cf. G. I, 451).

دزد - کیاو thief, brigand Evidently the dots are misplaced and one must read کناو, now spelt *genäw*, freely used by gypsies (cf. G. II, 287).

شتر - (?) لیمولو camel Porobably originally a 'general name; for domestic animals, the same as Qāīnī *limar* or *limur* (G. I, 452) and Sīrjānī *limru* (or, easily, *limuru*), which mean generally 'cattle.' The liquida *l* and *r* are easily interchangeable in gypsy dialects.

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[1] *See* Sir Percy Sykes's notice on the Gypsy language in the *Journal of the Anthropological Society*, vol. 25, p. 306 (1906).

[2] *See* Denys Bray, *Census Report of Baluchistan*, 1911, pp. 173 sq.

ماکته (?) - مادر mother. It may be a mistake for ماکثه a very common Persian Gypsy word, pronounced *mākis, māqis māqitha*, etc. (cf. G. I, 449 and 452).

نهور - چشم eye. A very common term amongst darwishes and gypsies.

هوسیت - نان bread. Cf. G. II, 285. Also a very common Gypsy and darwish word.

(*b*) *Words of Arabic origin.*

انبا - مردم خاص 'the chosen' (initiated ?), apparently for ابناء sons.

ابدک (or ابدل ?) - پدر father. Probably to be read ابیک , genitive of ابوک 'thy father.'

بطنا - شکم abdomen. (A. بطن and sf. -*ā*). D.

تعحت - حرامه courtesan ?

جعفر - طرار ruffian. (Probably originally an allusion to a particular person of this name).

جمادة - مرکب a riding animal, ship.

حقای (i.e. حقائي or حقاني) - راست true. (From A. حق). The form *ḥaqqānī* is extremely common amongst darwishes.

راسجه - گوش ear. (From A. رأس and P. sf. جه ?)

زبف - بد bad, wicked A., unchanged.

سهل - سني a Sunnite, lit. 'light,' perhaps 'loose.'

سهم - همه all. (Perhaps a bad ligature for سالم entire, intact).

شکرا - دروغ lie, wrong. (A. شکر and jargonic sf. -*ā*).

شهدا - زاهد ascetic, hermit.

صهاک - صوفي a Sufi. (A. ضحاک 'one who mocks'?). It is remarkable that the followers of the sect 'Alī-ilahī use this name for one of the incarnations of the Deity, Sulṭān Ṣahāk; they insist on this orthography of this word

عنقا - گردن neck. (A. عنق and the same sf. -*ā*). D.

غنما - گوسبند cattle. The same formation. D.

فما - دهان mouth. The same formation. D.

قبلا - بوسه kiss. (A. قبلة).

قحتان - جنگ war. (?)

قلبا - دل heart, stomach. The same formation. D.

قلت - اندک little, few.

لسانا - زبان tongue, language. The same formation. D.

ملک - مرد man.

امیر - ملکا prince.
سک - ملکاني dog.
مرده - میت dead. Arabic word, unchanged. D.
عوام - (?) ناشي common people (perhaps a mistake for ناس ?)
حاجي - نورک a pilgrim. (A. نور and P. sf. *-ak*. But why !)
روی - وجها face. A. word and sf. *ā*. D.
دست - ردا hand. ,, ,, ,, ,, ,, D.

(*c*) *Words of Persian origin, used metaphorically.*

کرده - جمانیده done, made (apparently a vulgar form for جنبانیده).
عزیزي - زنبوري a friend, probably from زنبور 'bee,' used as a conventional term for a correligionist (just as *naḥla* amongst the Nuṣayris of Syria).
غلام - (?) ناز boy.
میل - (?) وادبده desire. (?)

(*d*) *Words altered by transposition of syllables, etc.*

تنبل - تبلل lazy, idle.
دبک - کیت caldron. D. (quite common).
شهر - ماهون town, city. Evidently for هامون.

(*e*) *Words of uncertain origin.*

دف نای جنک - برکاله تر tambourine, or (?) flute, or (?) harp.
فتنه - برمیا calamity, mutiny.
حاجي - (?) بژادار pilgrim.
عالم - بشرک learned. (A. بشر and P. sf. *-ak* ?.)
غازي - بیس brigand. (Perhaps in some way connected with the P. dialectical *pis*, used for 'bad,' 'low,' 'wicked' in the district of Tūy and Sirkān, near Hamadān.)
خایه - بیسه testicle.
شیعي - (or حدل ?) حدک a Shi'ite.
بینا - داد one who sees well.
کاو - دریکان cow, bull.
خانه - (or دکه) دله house. سرای دار - (or بردکه) بردله house master.
شکایت - دناب complaint. (Perhaps connected with A. root ذنب ?)
بیني - ربهاجه nose.
علومي - شغتکا learned (?).

دندان - کاکا tooth.
بد - کشتا bad, wrong. (Perhaps connected with P. گشتن ?)
انکشت - لکته finger.
موی سر - مرزبات hair.
قمار باز - منکاکر gambler.
نهان - (?) وکب hidden.
هران - (*sic*) خونده (for خوانده ?) reading, calling.

(*f*) *Numerals.*

یک - هادک one. A. ?
سیم (or شیم) - دو two.
سه - سلوس three. (A. ثلاثة.)
جهار - اربا four. (A. اربعة.)
پنج - خمسا five. (A. خمسة.)
شش - شتا six. (A. ستة.)
هفت - خمسا و سیم seven. (5 + 2.)
هشت - خمسا و سلوس eight. (5 + 3.)
نه - خمسا و اربا nine. (5 + 4.)
ده - عشرات ten. (A. عشرة.)
بیست - سیم عشرات twenty. (Two 'tens'.)
سي - سلوس عشرات thirty. (Three 'tens'), etc.
صد - اما hundred. (A. مائة.) سیم اما - 200, etc.
هزار - الفا thousand. (A. الف.)

(*g*) *Proper names.*

فاطمه - اسمار جهن Fāṭima. (lit. 'good woman' ?).
عائشه - اسمار زیف 'Āisha (lit. 'bad woman' ?—because she was opposed to 'Alī).
منصور - بحر Manṣūr (Ḥallāj ?), lit. 'sea,' A.
ابو بکر - بوزه Abū-Bakr.
جلک (or حلک) - علي 'Alī (ibn Abī Ṭālib, the Imām). Met.?
ابوطالب - جوینده Abū Ṭālib (a literal translation of the Arabic name into Persian).
حاروبند (جاروبند) - زکریا Zachariah.
ابو القاسم - خلیفه Abū'l-Qāsim, see above.
عمر - داد 'Umar.
حسین - دلک Ḥusayn, son of 'Alī, the Imām.
دىىل (or دىدک) - محمد Muḥammad.

دنه وبغانان - خدیجه Khadīja (the first wife of Muḥammad).
دبفا (or دبغا) - ترک Turk.
رهمانا - خدا God, obviously a modified رحمن.
زاغی - کیل Gīlān (a province of Persia) (very doubtful).
عشق - ابو سعد (or ابوسعید ?) Abū Saʻd (see above).
کمار - یحیی St. John.
کورستاني (or نورستاني ، لورستاني) Jesus. Lit. 'one (who returned) from the cemetery' (i.e. resurrected) ?
ملکیا - دیلم Daylam, a Persian province, lit. 'the country'?—Perhaps the country *par excellence* of the sect ?
هرست (or هرسب) - احمد Aḥmad.
هلوک - حسن Ḥasan, the Imām. (Obviously from A. حلول 'incarnation,' and P. sf. -*ak*).
هو با کار (?) - موسی Moses.

27. The Sources of Jami's Nafahat.

By W. IVANOW.

Not many biographical and hagiological works in Persian literature have attained the exceptional popularity of Jami's well-known *Nafaḥātu'l-uns* Since its completion, in 883 A.H. (1478 A.D.) it has exercised an enormous influence upon contemporary and later writers It contains the fullest available collection of biographies of the leading Sufic saints who lived from the beginning of the movement till the first appearance of signs of its decay. The book undoubtedly constitutes an important authority on the religious, social and even literary development of Muhammadanism in Western Asia.

As we learn from the preface, Jami's original intention was not to write a complete and systematic history of Sufism. His aim was limited to re-editing an earlier hagiological work of 'Abdu'l-lah Anṣārī, the famous Shaykh of Herat, who died in 481 A.H /1088 A.D. This work, the *Ṭabaqāt*, deals with the legendary 'Golden Age' of the movement, its earliest period, in which the Sufic virtues are believed to have been in their full bloom. In his works Jami never appears as an impartial historian, but as a divine, a Sufi. and a poet. Therefore it is not improbable that this legendary poetico-didactic element was exactly what attracted him most, and that the subsequent additions were of less importance to him.

No MSS. of the *Ṭabaqāt* are found in Europe; a copy of it has been since 1799 in possession first of the College of Fort William and afterwards of the Asiatic Society of Bengal, both in Calcutta The existence of this work is of great importance for a critical study of the text of the *Nafaḥāt*. As it is very rare, it would be a mistake to omit making a preliminary reconnaissance in order to fix with some degree of precision the relation between these two works. Such an inquiry, however, inevitably involves the question of Jami's other authorities as well, and the importance of the *Nafaḥāt* makes an attempt to undertake such an analysis worth while

Unfortunately this is not an easy task. Jami's manner of not mentioning the sources of his borrowings only permits the possibility of establishing a connection between passages in his work and in other treatises where there is an opportunity of collation. This is sometimes not practicable, because some of his authorities are very rare, others are altogether lost, and others again are not locally accessible for reference. Therefore the sources of a number of biographies can only be hypothetically identified, whilst in some other cases identification must be left to some lucky future chance.

It is difficult to determine to what extent the pictures of early Sufism painted by Anṣārī and other early writers reflect a real state of things. These legends may have greater claim on the attention of a student of folklore than on that of an historian. But unfortunately even stories of this kind become scarce for the subsequent periods. When the movement had already grown into a mighty social factor, our information about it becomes particularly meagre. Jami, being probably conscious of the immensity of the task which a systematic narrative of the evolution of Sufism would involve, wisely preferred to restrict his work to mentioning only the most prominent personalities, the 'stars of first magnitude,' whose names were undoubtedly popular in Sufic tradition and familiar to every real darwish of his time.

The full list of the various works mentioned in the text of the *Nafaḥāt* is rather long. But an examination of the individual entries constituting it reveals the fact that the great majority of them were not perused by Jami, and that their titles are merely reproduced in their original context from his authorities. His own reference library must have been rather small. But even of some of the few works contained in it Jami did not wish to make full use. Besides Anṣārī's work, he derives his information chiefly from a few favourite books, such as those of Yāfi'ī and Hujwīrī, or treatises which were a subject of his special studies, such as 'Irāqī's *Lama'āt* and the *Fuṣūṣu'l-ḥikam* of Ibnu'l-'Arabī on which he composed commentaries.

In his choice of authorities, as well as in his selection of the subjects of his biographies, Jami often shows peculiar inconsistencies and prejudices. Thus he mentions with all the usual show of veneration some saints of somewhat questionable orthodoxy, such as Ḥallāj, 'Aynu'l-Quḍāt Hamadānī, Shihābu'd-Dīn Maqtūl, etc., who perished at the hands of the executioner. Even 'Adī b. Musāfir, the prophet of the Yazīdīs, is noted (No. 529).[1] But, at the same time, he appears to be particularly sensitive to the usual allegation of heterodoxy with regard to a poet of incomparably greater genius and influence than Jami himself, the great Jalālu'd-Dīn Rūmī. He openly scoffs at him, and his biography teems with real hostility.

Similarly, he narrates the biography of Sayyid Qāsim-i-Anwār, a Shi'ite saint and poet, whose connection with some secret Shi'itic movement is very probable.[2] It is true that he tries to dissociate the saint from his followers, whom he regards as obnoxious heretics, outside the pale of Islam (p. 690). But at the same time he systematically ignores all saints who had any relation with Shi'ism. So he entirely omits all the famous Sufic ancestors of the rising Safawide dynasty, although there can be no doubt that they were much discussed in his time,[1] and that the MSS. of *Ṣifwatu'ṣ-ṣafā*, in which their lives are recorded, were not uncommon Probably for the same reason he omits the famous Ni'matu'l-lah Walī, Sayyid Nūrbakhsh, Shaykh Ādharī, with their associates, as well as many others.[2] But most amazing is his disregard for 'Aṭṭār's beautiful *Tadhkira*. He mentions it only once (p 697) in the biography of that poet, borrowed, as we will see later, from a work of Indian origin, *Laṭāif-i-ashrafī*. It is highly improbable that Jami should never have seen it. Copies of the *Tadhkira* dating from Jami's time and earlier are still very numerous; therefore this omission can only be intentional. Besides 'Aṭṭār's biography, his name is mentioned only five times in the course of the whole book (pp. 21, 447, 531, 534, 540), usually in a context of extracts from other treatises. The mere enterprise of a re-edition of Anṣārī's *Ṭaboqāt* shows that Jami was not satisfied with 'Aṭṭār's *Tadhkira*, which deals with the same subjects This strange fact may find its easiest explanation in 'Aṭṭār's well-known Shi'itic tendencies which in some of his works amount almost to the beliefs of the Shi'ite extremists, and certainly would be very repugnant to Jami's piety.

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[1] All numbers of biographies or pages in this paper refer to Nassau-Lees' edition of the *Nafaḥātu'l-uns*, Calcutta, 1859.

[2] Cf. E. Browne, A History of Persian Literature under Tatar dominion, 1920, pp. 473–475.

In handling his authorities Jami rarely reproduces them in their integrity. He obviously avoids long stories. and when he had at his disposal a circumstantial monograph on a saint, he used to condense it into a few pages, but summarised in additional separate biographies the narratives about the secondary personages menitoned therein. Whenever he leaves them together it is of great help in tracing his original sources. But this does not always happen, and more often Jami changes the order of the biographies as they are given in the work from which he borrows them, scatters them about in his book, and alters the order not only of separate anecdotes but even of sentences, usually for reasons which are not apparent. His arrangement, generally speaking, is chaotic. The impression which one receives from a study of his work is that it was originally written on separate slips which were transcribed into a book without proper arrangement. There are many instances of glaring violation of chronological sequence or, on the contrary, scattering contemporary biographies about in sections dealing with different periods.

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[1] In fact Jami mentions once (p. 672) the greatest of them, Ṣafiyyu'd-Dīn Ardabīlī.

[2] The suggestion that the latter two were not included in the *Nafaḥāt* because they died only less than 20 years before the completion of the book does not explain the omission, because Jami mentions six saints whose deaths took place between 857 and 865 A.H., and also several others who were still alive when he wrote his work.

As to the question of literary style, it is possible to think that Jami did not pay any special attention to it. He usually very closely follows the general spirit of his originals. The text of the *Ṭabaqāt* he usually reproduces literally, only replacing old forms of words by modern ones. But in many cases also he changes the wording, probably quoting from memory or for the purpose of condensation. It is strange to see that in notices which are probably due to his own authorship his language is rather inflated, filled with frequent (and apparently quite unnecessary) Arabic quotations and versified passages.

The biographies which are entirely due to his pen are chiefly of two kinds. The majority are based on oral tradition, on personal acquaintance, or on such information as he could gather about his contemporaries. To this type belong all the biographies of the saints of the Naqshbandī affiliation (Nos. 434–452), as well as of his other contemporaries and of some of their predecessors (Nos. 468 *bis*, 483–484, 506–512). He often refers to the oral tradition which he heard, although he never mentions his *rāwī* (cf. pp. 434, 445, 448, 449, 450, 454, 465, and many others). It is impossible to discover whether he knew and perused the old literature on the early saints of Turkestan, of whom some were regarded later as members of the Naqshbandī affiliation. Some books of this literature exist even nowadays, including the well-known works of Jami's early contemporary Muḥammad Pārsā, and it is incredible that such an eminent member of this Sufic association as Jami should never have heard of them There was one early work, probably composed in the VIIc. A.H. by 'Abdu'l-lāh b. Mas'ūd 'Alī.b. 'Umar as-Ṣarrāf, dealing with the saints of Turkestan, bearing the title *Ḥiṣaṣu'l-atqiyā min qiṣaṣi'l-anbiyā*, and another, *Manāqib-i-Amīr Kulāl*, composed by an anonymous author in 808 A H [1]

The other type of Jami's own biographical notices is based on his own analysis of the works which he perused, and deals with the authors of these compositions. He used this method apparently only when a ready biography was not available. To this type belongs, amongst others, one of the most important notices, i.e. on 'Abdu'l-lah Anṣārī, based almost entirely on his own *Ṭabaqāt*, with probably little addition of the narrative from other sources. Very typical is the case of the account of Yāfi'ī (cf. p. 682).

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[1] Both MSS., the first a very old copy, were purchased by me in 1915 in Turkestan and are preserved in the Asiatic Museum of the Russian Academy of Sciences, Petrograd, Nos. 602 and 539 in the collection bearing my name.

It is a great pity that so important a work as the *Nafaḥāt* remains without a proper critical edition, although its MSS. are very common and there are even very old copies of it (at Petrograd). It was lithographed several times in India and Persia, and printed by W. Nassau-Lees, Calcutta, 1859. The latter publication, although the best of all available, is still very far from being a really critical edition. It was based on unsatisfactory MSS. (there are no good MSS. of the *Nafaḥāt* in Calcutta), contains many misprints or terrible 'emendations' of the text, and besides, is very difficult for perusal, because the *fihrist* of the biographies, appended to it, is of limited utility for a book every page of which contains names, quotations. titles of books, dates, etc , all of which are very important for reference. In addition it is now extremely scarce, more than 60 years having passed since its publication, scarcer indeed than good MSS. of the *Nafaḥāt*, and only few libraries possess it.

I. *Ṭabaqāt of 'Abdu'l-lāh Anṣārī.* As was mentioned above, Jami explicitly states in his preface (pp. 1–2) that his original intention was to re-edit in a modernized form this early treatise. As he remarks, there was great need for the correction of Anṣārī's text, because the book had suffered badly at the hands of ignorant and inaccurate copyists, who in their attempts at 'emendation' of the original uncommon forms made the narrative incomprehensible in many places. These uncommon forms and idioms Jami attributes to the peculiarities of the old dialect spoken in Anṣārī's days at Herat, and this is partly correct. The treatise undoubtedly presents the greatest interest from the linguistic point of view This side of the question has been analysed by me elsewhere[1] and I will confine discussion here only to its contents.

The work, as may be gathered from internal evidence. was compiled by one of Anṣārī's disciples. who does not mention his name,[2] apparently shortly after the Shaykh's death.[3] It contains a summary of Anṣārī's lectures,[4] which were devoted to the criticism, correction and amplification of *Ṭabaqātu's-ṣūfiyya,* an earlier hagiological treatise, in Arabic, by Abū 'Abdi'r-Raḥmān Sulamī, a divine and a Sufi of Nishapur, who died in 412 A.H./1021 A.D. It is still accessible in several MSS. in various European libraries.[1]

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[1] See my article 'Tabaqat of Ansari in the old Language of Herat,' the first part of which has appeared in the January number of the Journal of the Royal Asiatic Society, 1923, pp. 1-34. The second part appeared in the July issue, pp. 337–382

[2] He often refers to Anṣārī as to his *rāwī*, cf. fol. 46v, 115v, 124v, 130, 147v. There are also many allusions to his conversation with the Shaykh, cf. fol. 33v, شیخ الاسلام کفت مرا or on f. 86v. کفت (شیخ), توحید داني چیست etc.

[3] Cf. fol. 114v. شیخ الاسلام بآخر عمرتن چند جدا کرد از مشائخ الخ

[4] That an assembly, obviously of disciples, was addressed, one may

The MS. of the *Ṭabaqāt* belonging to the Asiatic Society of Bengal (marked D 232, formerly 536) was transcribed just before 1015 A H./1606 A.D. (the date of collation), and is still in a fairly good state of preservation. The work is divided into 120 principal biographies, or rather groups, because there are many secondary personages whose mention is involved in the narrative of the chief saint. Jami splits up these accumulations and expands them into about 350 separate biographical notices, i.e. Nos. 1–19, 22–30, 32, 33, 35, 36, 39, 40, 42–71, 73–76, 78, 80–128, 130, 132–153, 155–170, 172–184, 186–204, 206–235, 237–317 (318?), 319, 324–352, 355, 356, 358, 359, 373, 381, 382, 386, 394–422, 425,[2] which are entirely or chiefly based on the *Ṭabaqāt.*

In Anṣārī's work the saints are arranged by generations (*ṭabaqa*), six in all,[3] but occasionally the biographies of the members of one *ṭabaqa* are inserted in the section containing the stories of the shaykhs of a quite different period, especially in the second half of the book.

This already imperfect order of arrangement Jami changes into real chaos. Although, as was mentioned above, he usually reproduces the wording of Anṣārī's text very carefully, in a modernized form, he tears to pieces the sequence of the narrative, changes the order of the anecdotes and even sentences, omits some of them, condenses others, etc., and completely disregards their original, as well as chronological, order. To be fair, he pays at the same time great attention to dates and is remarkably accurate therein as compared with many other hagiologists. He inserts into Anṣārī's narrative a number of additional anecdotes, and even entire biographies,

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conjecture from the plural forms in various references to these lectures, cf. (fol. 2.) شیخ بما وصیت کرد، (fol. 4.) شیخ بر ما املا کرد، (f. 99v) شیخ الاسلام وصیت کرد و کفت این سخن نوبسید و باد کیربد،

[1] See C. Brockelmann, Gesch d. Arab. Litteratur, vol. I, pp. 200–201. His *Ṭabaqāt* is described in Ahlwardt's Catalogue, No. 9972 (Vol. IX, p. 408 sq.); another copy is found in the British Museum, Add. 18520.

[2] As some biographies are composed of information taken from various sources, their numbers may be referred to in several places, under the titles of the treatises from which parts of the narrative were borrowed (small or accidental additions being disregarded).

[3] Sulamī's book contains only five generations, each comprising twenty biographies. In Anṣārī's book the number of notices in each *ṭabaqa* is different, sometimes more than twenty, sometimes less, and a sixth generation is added.

apparently from Yāfi'ī and Hujwīrī. The number of such insertions is not large in the text corresponding to the first half of the *Ṭabaqāt*, but in the second they are so numerous, and are so often made hap-hazardly, that the integrity of the original work is entirely broken. It seems however that there are only a few names in the *Ṭabaqāt* which do not reappear in Jami's book, and so one may conclude that in spite of the great confusion the text of Anṣārī's work is reproduced almost entirely. The omissions consist chiefly of quotations of Arabic poetry, of moral reflexions connected with the anecdotes, as well as of some opinions of Anṣārī which Jami apparently did not share.

The information which Jami did not appreciate and usually omits in his book often contains references to early Sufic literature. The learned Anṣārī undoubtedly took a great interest in it and probably read much of what he mentions. These books, of which only a few are extant nowadays, may be regarded as the sources of the *Ṭabaqāt* and therefore, indirectly, of the *Nafaḥāt* For this reason it seems desirable to enumerate them here, and this list, based on the information of such a competent and trustworthy person as the Pir of Herat may be of some use to the students of Sufic literature.

Unfortunately Anṣārī is very often not quite accurate in his quotation of titles, and sometimes it is impossible to decide whether he has perused the works mentioned, or not. This is a list of the treatises, arranged chronologically.

1. *'Abdu'l-lah Nibājī*, a saint of the beginning of the IIIc. A.H., an associate of Dhū'n-Nūn Miṣrī (cf. *Nafaḥāt*, pp. 101–102, and *Luma'*, ed. R Nicholson, preface, p. XXX). His كتاب زهد is mentioned (fol. 59) : از سهل عاصم كتابی زهد كرده و از وی حكايت كند .

2. *Aḥmad b. Abī'l-Ḥawārī*, d. 230 A.H. (cf. *Nafaḥāt*, p 72), or between 230 and 246 A.H. (see *Luma'*, ibid.). One of his books is referred to without title (f 64v), and the Shaykh had perused it : در كتاب احمد ابی الحواري ديدم.

3. *Ḥārith b. Asad Muḥāsibī*, d. 243 A.H. (پس از احمد حنبل بدو سال as Anṣārī says. Brockelmann, Gesch. d. Ar. Lit , vol. I, p. 198, gives the date of his death as 213 A.H.). Besides a general notice of his literary works (f. 24), the titles of two of his treatises are given (ibid.) : كتاب رغائب probably an inaccurate reproduction of مقاصد الرعاية (Cairo, II, 87), mentioned by Brockelmann, loc. cit., and كتاب معرفت, apparently the same as شرح المعرفة و بذل النصيحة (Brock , ibid , Ahlwardt Cat., No. 2315).

4. *Shāh Shujā' Kirmānī*, d. between 270 and 300 A.H. The whole complex of stories about this princely saint seems

to be largely a reproduction of folk-lore tales, probably of very old origin ‘Aṭṭār, I, 312–315, apparently used the same authority as Anṣārī, the difference in their texts being often only a question of wording. Quite possibly both borrowed this biography from the book of ‘Abdu’l-lah Khafīf Shīrāzī, (see below, No. 18). It seems therefore quite surprising that not only various treatises are ascribed to him (f. 56, رسالت ، كتب), but that they even probably existed, because their contents are concretely specified in some cases as (f. 56) كتاب .. رد يحيى معاذ رازي در فضل غنا بر فقر (cf. *Nafaḥāt*, p. 95). Even ‘Aṭṭār, who only very rarely gives any dates or references to other books, mentions in his *Tadhkira* (ibid.) the book مرآة الحكماء ascribed to this saint; some of his epistles are also referred to in *Luma*‘, p. 238 of the text.

5. *Muḥammad b. Yūsuf Bannā ath-Thaqafī*, of Iṣfahān, d. 280 A H. (cf. also *Luma*‘, pref., p. XXIII). Besides the general mention of his works (تصانيف, f. 34v), two individual titles appear, i.e. كتاب السنة فى الاعمال and سنان العارفين (ibid.).

6. *Isḥāq b. Ayyūb*, probably of the same period (as Anṣārī says شاكرد سهل بن عبد الله تسدری). His small pamphlet (جزو f. 35v) is mentioned.

7. *Abū ‘Amr Nūqānī*, also apparently of the same time, an early saint of Khorasan. His book referred to here is called محبة الظراف (f. 45v. It may be read also محنة الظراف).

8. *Abū Sa‘īd Kharrāz*, d. 286 A.H., a saint of very high repute (cf. f. 43v. خراز كاستيد كه بيغامبر بودي). ‘Aṭṭār (I, 40) ascribes to him no less than 400 works, but Anṣārī, in spite of his great veneration, had probably never seen any one of them, and mentions only the fact of his literary activity (f 41, تصانيف).

9. *Ibrāhīm b. Aḥmad Khawwāṣ*, d. 291 A.H. (ار درست شود ‘if this date is correct,’ as Anṣārī remarks). His ‘book’ (f. 78, كتاب) is mentioned, and the Shaykh had seen it.

10. *‘Amr b. ‘Uthmān al-Makkī*, d. 291 or 297 A.H., the celebrated teacher of Ḥallāj (cf. also ‘Aṭṭār, II, 36–40). He was the author of some treatises, apparently not quite orthodox, and suffered persecution (f. 53 سخن او باربک شد وبرا بکلام منسوب کردند و مهجور کردند و از مکه بیرون کردند). His تصانيف are mentioned on f. 85.

11. *Abū’l-Qāsim Junayd*, d. 299 A.H. The literary works of this famous Sufi, usually believed to be the first Sufic writer, are often referred to in the *Ṭabaqāt*, but only once a definite title is given (f. 96). It is سرّ نامه, most probably the same as

كتاب السرّ في انفاس الصوفية (Cairo, II, 87, see Brockelmann, I, 199).

12. *Ḥusayn-i-Manṣūr Ḥallāj*, d. 309 A.H. Anṣārī discusses at length the question as to whether it would be compatible with being an orthodox Muhammadan to recognize this personage as a saint. It is rather surprising, having regard to his strict opinions, that he decides to admit that Ḥallāj had been misunderstood. His 'eloquent poetry' (f. 86v. شعر فصيح) and some 'unknown books' (ibid. كتابهاى نا معروف) are mentioned besides his (f. 103v) كتاب عين جمع (which is referred to also in the *Nafaḥāt*, p. 209).

13. *Abū'l-'Abbās b. 'Aṭā*, executed in connection with the case of Ḥallāj, in the same year, 309 A.H. Anṣārī not only states that he was the author of some تصانيف (f. 79v), but even describes them as follows (ibid.). وى را سخنست نيكو و زبان فصيح در فهم قرآن و كتب بسيار ست در فهم قرآن بر زبان صوفيان ، تفسير قرآن از اول تا آخر بزبان اشارت ،

14. *Muḥammad b. 'Alī Tarmīdhī*, usually known as *Abū Bakr Warrāq*, d. 302 A.H. (cf. Brockelmann, I. 199, where several of his still extant works are enumerated). Besides تصانيف (f. 70v) and كتب (f 72v), his ديوان شعر (ibid.) and كتاب عالم و متعالم (ibid) are mentioned

15. *Abū 'Alī Jūzjānī* (*Gūzgānī*). Warrāq' contemporary and fellow-countryman, who also composed some works (f. 74, تصانيف). Cf. also 'Aṭṭār, II, 118 sq. and *Nafaḥāt*, p. 143.

16. *Abū Bakr Wāsiṭī*, d. 320 A H.. also produced a book, which Anṣārī had an opportunity of seeing (f. 70): بخط محمد بن علي بندار ديدم در كتابى كه واسطى كفته .

17. *Yūsuf b. Ḥamdān Sūsī*, apparently of the same period, also produced some تصانيف (f. 76v).

18. *Abū 'Abdu'l-lah b. Khafīf Shīrāzī*, d. 331 A.H. His book, which Anṣārī calls كتاب اسامي مشائخ پارس (f. 31), probably not by its proper title, was apparently one of the chief sources of the *Ṭabaqāt*. This was not however the only work ascribed to that saint, because his تصانيف are mentioned on f. 118 (cf. also 'Aṭṭār, II, 125). Anṣārī generously compliments him on the soundness of his religious and Ṣufic opinions, but at the same time he does not miss the opportunity of making rather unfavourable remarks, ascribed to contemporaries of that saint, with regard to his pride and self-aggrandisement. It is remarkable that this early attempt to record the history of the still young movement was not an isolated case. As we will

see from the next two numbers,[1] other Sufis in different corners of Iran tried to do the same.

19. *Abū Bakr Paykandī*, apparently of the same period, a disciple of Abū 'Abdi'l-lah Maghribī and the teacher of the next author, Abū Bakr Rāzī. He wrote a book which Anṣārī calls تواریخ (f. 102v).

20. *Abū Bakr Rāzī.* He composed a تاریخ (f. 115v), on which Sulamī's *Ta'rīkh-i-ṣūfiyya* was based.

21. *Abū Sa'īd A'rābī*, d 341 A.H., was the author of several books (نصانیف f. 108v), such as کتاب وجد در سماع صوفیان and جزو نکت در نوحید (cf. *Nafaḥāt*, p. 247). The titles are obviously not genuine, and were given probably by Anṣārī himself merely to show the contents of these works.

22. *Ja'far Khuldī*, d. 348 A.H. (cf. *Luma'*, pref., p. XVII, and 'Aṭṭār, II, 283). Anṣārī says about him (f. 109v):

صاحب جمع کتب ناریخ و حکایات و جمع کردن (sic) سرت مشائخ و کفته
دوبست دیوان دارم از آن مشائخ

23. *Abū 'Abdi'l-lah Rūdbārī*, d. 369 A.H. (cf. *Luma'*, pref., p. XVIII, sq.). His book کناب آداب فقرا is mentioned (f. 122, cf. *Nafaḥāt*, p 300).

24. *Abū Naṣr Sarrāj*, d. 378 A.H. (cf. *Luma'*, pref., IV). It is very interesting that Anṣārī not only had a poor opinion of his *Luma'*, but even denied Sarrāj's authorship of it, ascribing it to a different person, Abū Bakr Mufīd, who died, according to Anṣārī's statement, in 364 A.H. (cf. *Nafaḥāt*, p. 220). It would be interesting to find if this is simply a misunderstanding. No personage of this name appears in the *Luma'*, at least in R. Nicholson's edition. Jami, who apparently has not seen the *Luma'*, shows some scepticism towards this statement of Anṣārī's; the original passage, not reproduced in the *Nafaḥāt*, is worth quoting (ff. 112–112v):

(شیخ الاسلام کفت که) بوبکر مفید نام وی محمد بن احمد بن ابراهیم
است امام بود و بزرک بشهر جرجراباد، کتاب لمع از وبست اینکه سراج لمع بر
آرزوی وی کرده اما در بوی او نرسیده، یوسف بن حسین رازي و جنید دیده
بود در سنه اربع و ستین و ثلثمائة برفته از دنیا، شیخ عمو وی را دیده بود،
بابو عثمان صحبت داشته، عمر وی دراز بکشید نیکو ادب و شریف همت
و مستقیم احوال،

And he proceeds assuming it to be a fact that *Luma'* is due to Mufīd, همین ابوبکر مفید در لمعهٔ خود آورده الخ (f. 112v). Jami apparently did not agree with this and replaces the whole passage by a sentence referring only to Mufīd (*Nafaḥāt*, p. 220) :

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[1] See also Nos. 22 and 26.

وی را کتابی است در آنجا آورده که الخ

25. *Abū'l-Ḥasan Ṣayḥī*(?) or *Ṣubayḥī*, as in the *Nafaḥāt*, p. 182, and *Luma'*, pref , p. XXXII. He was the author of some treatises (تصانیف f. 89v).

26. *Abū'l-Ḥusayn Sallāmī*, also apparently of the same period, is called (f. 95) صاحب تاریخ (cf. *Nafaḥāt*, p. 186).

27. *Abū Manṣūr Mi'mar b. Aḥmad Iṣfahānī*, was probably still living in the beginning of the Vc. A.H. (احمد کوفاني وی را دیده). Jami (*Nafaḥāt*, p. 319) omits much of what is said about him in the *Ṭabaqāt*, as well as the titles of his books (f. 138) اربعین صوفیان and نهج الخاص (the title کتاب غربت may be merely a heading of a chapter in one of these works).

28. *Abū Sa'īd Mālīnī*, a Herātī shaykh of the end of the IV and the beginning of the Vc. A.H. Anṣārī relates from him only through an intermediate *rāwī*. His book was probably called اربعین (f. 70) or اربعین مشائخ (f. 114v).

29. *Abū 'Abdi'r-Raḥmān Sulamī*, d. 412 A.H. (see about him above; also refer to No. 20 in this list)

30. *Abū'l-Qāsim Qushayrī*, d. 465 A.H. It is difficult to decide whether Anṣārī has read his well-known *Risāla*. All he says is (f. 138v) :

استاد ابو القاسم قشيري داماد وی (ابوبکر وراق) بود و شاکرد وی
و مجالس وی جمع کرده بود

It is obvious that this list does not represent the full extent of Sufic literature in Anṣārī's time. Many works probably already existed, and new ones were in process of composition, e.g. the well-known *Kashfu'l-maḥjūb*. On the other hand it seems probable that not all works enumerated here were of purely Sufic content. Possibly also some of them were attributed to various saints by their pious admirers simply by way of veneration.

It would not be out of place to look into the question of Anṣārī's own works. Some of them, namely his *Munājāt* and *Manāzilu's-sāirīn*, the latter in Arabic and Persian versions, are very common and well-known. The others, *Kanzu's-sālikīn*[1] and *Anīsu'l-murīdīn wa shamsu'l-majālis* (containing the story of Yūsuf and Zulaykhā),[1] are also known. All the more reason to expect that they were known also to Anṣārī's devoted disciple, who naturally would not neglect them when compiling the *Ṭabaqāt,* just after the Shaykh's death. But although he dwells much on Anṣārī's talents as an Arabic poet, quotes occasionally his *Munājāt,* and refers to some of his notes (جزوها),[2] he does not say a single word about any of the other works. It is interesting that he mentions a work by Anṣārī which is probably lost, his *Maqāmāt.* The details which he gives are not sufficient to form an opinion about the real nature of this work and to decide whether it would be possible to suggest that this work is identical with *Manāzilu's-sāirīn.*[3] It is noteworthy that there is also no allusion to the Shaykh's Persian poetry, so plentifully quoted in the works ascribed to him.

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[1] There is a copy of it in the library of the A.S.B. (E 147) and another in the Būhār collection (No. 165 of the Catalogue). The style, language, spirit, etc., of this work have no resemblance to that of the *Ṭabaqāt* or *Munājāt*, although the numerous poetical quotations invariably contain the takhalluṣ *Anṣārī*.

II. *Qushayriyya.* The well-known treatise of Abū'l-Qāsim Qushayrī of Nishapur (d. 465 A.H. 1072 A.D.) was left almost unused by Jami. He refers to is as an authority only twice (pp. 4 and 89), and although he mentions Qushayrī himself more than half a dozen times, the latter is not referred to as a *rāwī.* His biography (p. 355) is very short and based on *Kashfu'l-maḥjūb.*

III. *Kashfu'l-maḥjūb,* by 'Alī b. 'Uthmān al-Jullābī al-Hujwīrī, d. between 465 and 469 A.H. 1072–1076 A.D. It is one of the favourite sources of Jami, being referred to often. Jami uses his narrative chiefly for additional anecdotes, inserted in the text, taken from other works especially the *Ṭabaqāt.* The biographies which are entirely or chiefly based on this work are not numerous (Nos. 351, 353, 354, 355, 365, 367–369, 374–380). Hujwīrī's own biography (No. 377, pp. 358–359) is one of the vaguest in the *Nafaḥāt* and is based on an analysis of the *Kashf* itself.

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[1] The same can be also said of this work (see the preceding footnote). There was a copy of it known in the India Office library (see No. 1458 of Ethé's Catalogue), and I found another in Turkestan (now in the Asiatic Museum, Petrograd). On the whole one is much inclined to think them forgeries.

[2] Cf. f. 86: خبری که بفنای خود و بفای حق در جزوها بخط شیخ الاسلام نوشنه بود الخ . Does this mean that the author carefully studied the literary inheritance left by the Shaykh ?

[3] See f. 69: شیخ الاسلام در مقامات خود از کسی حکایت نکند مکر بر سر مقامات و بنای او از این سه جهار تن. Jami omits this passage, but several times he mentions مقامات شیخ (or جامع) صاحب (cf. pp. 376, 382, 397), alluding apparently to the author of the *Ṭabaqāt.* He refers also to *Manāzilu's-sāirīn,* accepting Anṣārī's authorship of it as a fact, once in his preface (p. 20), and twice in connection with saints of the end of the VII and VIIIc. A.H. (pp. 568 and 666).

I need not dwell on the value of the information found in this work, and may refer the reader to the notes in Prof. R. Nicholson's translation, published in the Gibb Memorial Series, Vol. XVII, 1911, which is of great help to every student of Sufism. I will add only a few words about the editions of the original text. It was lithographed several times at Lahore, but a better lithography appeared in 1914 at Samarqand. About 25 years ago it was critically edited in Petrograd by the late Prof. V. Zhukovsky, from several good MSS. This edition, however, was not issued to the public, because the editor did not wish to publish it without an introduction, for which he was arranging to secure extracts from various rare MSS. The matter was continually postponed, until Prof. V. Zhukovsky suddenly died in January 1918.

IV. *Works of 'Aynu'l-Quḍāt Hamadānī*, with his original name of Abū'l-Ma'ālī (or Abū'l-Faḍāil) 'Abdu'l-lah b. Muḥammad Miyānajī, executed *ca.* 533 A.H./1139 A.D. He was the author of the well-known *Tamhīdāt*, sometimes called also *Zubdatu'l-ḥaqāiq* (as in the *Nafaḥāt*, p. 476. Cf. also Sachau and Ethé, Cat. of the Persian, etc., MSS. in the Bodleian library, No. 1247), and of another, much rarer, work on Sufism, a collection of his epistles (a MS. of it is described by Rieu, Cat. of the Pers. MSS. in the British Museum, vol. I. p. 412). Jami calls it *Maktūbāt* (cf. pp. 350 and 474), and it is most probably identical with what he calls *Rasāil* (pp. 350, 374, 475). These works, especially the letters (as it seems), were freely perused by Jami, but it is very difficult to state precisely which biographies are based on them because the *Maktūbāt*, which are rare, are not accessible in Calcutta. The notices probably extracted from them may be Nos. 79(?), 369, 370, 383(?), 429, (431–432?) 453–458, etc. Their author's biography (No. 456, pp 475–477) is also very vague and based on his own works, chiefly *Tamhīdāt* (cf. p. 476).

V. *Biography of Aḥmad-i-Jām.* Strange as it may seem, whilst the greatest Sufic saints and most talented Persian poets were only rarely honoured by biographical monographs, there were several, at least four, compositions of this kind devoted to the life of an illiterate darwish of local importance, Aḥmad-i-Jām, who died in 536 A.H./1141 A.D. I have already given some information on this point,[1] and here only a few words are sufficient. These books were composed: by Imām Muḥammad Ghaznawī, a learned divine, who for some reason associated himself with Aḥmad; another work, also by a disciple of that saint, Aḥmad-i-Tarakhistānī. It is uncertain whether a biography by Tāju'd-Dīn Muḥammad Būzjānī was really written, but another existed for certain, composed by Zaynu'd-Dīn Abū Bakr Tāibādī, d. 791 A.H. And the latest of all, of which a fragment was published by me in the paper referred to in the footnote, was written by an anonymous author about 840 A.H. (this year is mentioned in it as 'current').

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[1] See my paper 'A biography of Shaykh Aḥmad-i-Jam,' *JRAS*, 1917, pp. 291–365.

The Asiatic Society of Bengal possesses another copy of the last mentioned work (marked E 64). The title is given in the preface as *Khulāṣatu'l-maqāmāt,* but the author's name remains unknown. The MS. is very defective, because in addition to many lacunas it is badly mutilated by a book-binder, who pasted broad strips of (non-) transparent (and rapidly deteriorating) paper quite needlessly all over its pages, thus rendering them illegible. A collation shows that the fragment which is already published contains the most important part of the book. The remaining portions deal with spurious 'miracles,' and the preface seems to be a forgery.

It is not superfluous to mention that an old copy of an early biography of Aḥmad-i-Jām, possibly one of the two earliest compositions just mentioned above, was acquired in 1916, in the Caucasus, for the Asiatic Museum of the Russian Academy of Sciences. The MS. is slightly defective in the beginning so that the author's name is not to be found, but it contains a continuation to about the time of the Mongol invasion, dealing with the lives of Aḥmad's descendants. It seems most probable that this work was one of the chief authorities of the compiler of *Khulāṣatu'l-maqāmāt.*[1]

A collation of the text of the last mentioned work with corresponding portions in the *Nafaḥāt* shows that they coincide only in the wording of the quotations from the early monographs. But it is impossible to maintain only for this reason that Jami did not know this work of his contemporary. He may have changed the wording simply to condense it. As usual, he splits up the narrative into several separate biographies (Nos. 387–392, 426, 427), and uses this material also for the amplification of other stories.

VI. *Biography of Abū Sa'īd.* Similar difficulties as in the case of Aḥmad-i-Jām are to be met with in the question of the sources of Jami's materials for his biographies of Abū Sa'īd b. Abī'l-Khayr of Mayhana and his associates. Two early works dealing with his life are known at present, and are accessible in an excellent edition of Prof. V. Zhukovsky, 1899. The older, and smaller, work is usually called *Ḥālāt wa*

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[1] There is yet another rare MS. in the library of the A.S.B. (E 20), containing *Unsu't-tāibīn,* by Aḥmad i-Jām himself, or rather by one of his disciples, who recorded his somewhat common-place revelations. It is, however, much more interesting from the philological point of view than for a student of the history of Sufism.

sukhanān-i-Shaykh Abū Sa'īd, whilst the other bears the title *Asrāru't-tawḥīd fī maqāmāti'sh-Shaykh Abī Sa'īd.* The latter was composed between 553 and 599 A.H./1157-1203 A.D., by the saint's great-great-grandson, Muḥammad b. al-Munawwar. So far as its contents are concerned, Jami's (as well as 'Aṭṭār's) narrative agrees entirely with these early works. Only a few anecdotes are not found in them although they appear in the *Nafaḥāt*, but it is obvious that they may have been added from other sources. But in spite of this agreement the wording is invariably different, and although these changes may have been introduced intentionally, there are no definite grounds for either accepting or rejecting the suggestion about Jami's borrowing from the treatises named above. There exists a possibility also of the existence of some earlier works which have not come down to us.[1] Besides, the section of the *Nafaḥāt*, dealing with biographies of Abū Sa'īd and Aḥmad-i-Jām with their associates is one of the most difficult to analyse because the anecdotes from various sources are extremely intermixed here, invariably without any acknowledgment as to their origin. With some degree of probability it may be suggested (basing identification chiefly on the identity of the contents), that if the treatises mentioned above were perused by Jami, then Nos. 236(?), 353, 354, 357, 360–369(?) 371, 372, 380, 385(?) were chiefly based on them.

VII. *Works of Ibnu'l-'Arabī.* The classical works on Sufic doctrines by Muḥyī'd-Dīn Muḥammad b. 'Alī surnamed Ibnu'l-'Arabī, d. 638 A.H /1240 A.D., were freely perused by Jami who knew them well (and even composed a commentary on some of them). The majority of extracts are taken from *Fuṣūṣu'l-ḥikam*[2] and *Futūḥātu'l-Makkiyya*, referred to scores of times, but still more often reproduced without an acknowledgment. The biographies which are entirely derived from these treatises, or based on them in an essential degree, are probably Nos. 320(?), 371, 385, 432, 433, 523, 526–528, 535, 537, 563, 578–611, as well as some notices on the lives of the early saints inserted in the portion corresponding to the first half of the *Ṭabaqāt*.

VIII. *Mirṣādu'l-'ibād*, by Abū Bakr 'Abdu'l-lah b. Muḥammad Rāzī, surnamed Najmu'd-Dīn Dāya, d. *circa* 650 A.H./1252 A.D. His work is well known in many MSS. It was lithographed at Tehran, 1314 A.H. Besides, there is an old lithography of a collection of extracts from it. Jami mentions this book only once (p. 499), and apparently made little use of the interesting information it contains.

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[1] It is interesting to find the origin of the story of Abū Sa'īd given in *Kashfu'l-maḥjūb* (pp. 164–166 of Nicholson's translation). Some parts of it are obviously based on oral tradition but some other anecdotes sound like extracts from written sources.

[2] Jami even refers to various commentaries upon it, such as those by Ṣadru'd-Dīn Qūniyawī (d. 673 A.H./1274 A.D.), on pp. 637, 646; Mu'ayyidu'd-Dīn Jandī (d *circa* 690 A.H. 1291 A.D.), on pp. 493, 635, 648; and Sayyid 'Alī Hamadānī (d. 786 A.H./1384 A.D.), on p. 515. He mentions also several others.

IX. *Lama'āt*, by Fakhru'd-Dīn 'Irāqī, whose real name was Ibrāhīm Hamadānī, d. 688 A.H./1289 A.D Jami was particularly fond of this little treatise on which he composed his well-known commentary. He quotes it on pp. 427, 649, and refers to it on pp. 700–701, in the long biography devoted to the saint. There are indications that he used it in other places also.

X. *Manāqibu'l-'ārifīn*, by Shamsu'd-Dīn Aflākī, who composed it between 718 and 754 A H./1318–1353 A.D. Jami does not mention the title of the book or its author's name, but his narrative of Jalālu'd-Dīn Rūmī and his associates follows closely that authority in contents and arrangement, although Jami entirely changes its spirit, adding many hostile remarks, etc. The extracts comprise Nos. 488–494, and as they are found in the middle of the narrative apparently derived from a work of the VIIIc A.H., *Iqbāliyya* (see below No. XII), it is also possible that Jami reproduces them from this work and not directly from the *Manāqibu'l-'ārifīn*. Jami was not alone in his hostile attitude towards the last mentioned treatise, because many pious persons objected to it. So in India, towards the end of the VIIIc. A.H., Aḥmad b. Muḥammad, a disciple of the famous Jalālu'd-Dīn Bukhārī (d. 785 A.H.), thought it useful to prepare a new edition of it, eliminating all passages which might displease the fanatics.

XI. *Works of Yāfi'ī*, or, with his full name, 'Afīfu'd-Dīn 'Abdu'l-lah b. As'ad Yāfi'ī, d. 768 A H./1367 A.D The rich hagiological material given in his works was much appreciated by Jami who borrowed from it considerably He refers to Yāfi'ī very frequently, and probably omits to acknowledge his borrowings in at least as many other cases. But it is extremely difficult to determine for certain where he borrows directly from that source, and where indirectly through other works which were also based on the same authority. This could be probably only decided by a minute scrutiny of all three texts, i.e. Jami's, Yāfi'ī's, and that of the alleged intermediary. The biographies which contain a large proportion of the information from this source are Nos. 72(?), 459–468, (469?), 495(?), 516–523, 524–534, 536–538, 543–547(?), 549–562, 578–611, and some others.

Jami enumerates the works of Yāfi'ī which he consulted (p. 681); they were : (1) *Mir'ātu'l-jinān wa 'ibratu'l-yaqẓān, etc.*, usually called by him *Ta'rīkh.* (2) *Rawḍatu'r-riyāḥīn fī ḥikāyati's-ṣāliḥīn*, and (3) *Ad-Durru'n-naẓīm fī faḍā'ili'l-Qur'āni'l-'aẓīm* (see about all three Brockelmann, II, p. 177, Nos. 1, 11, 13).

XII *Risāla-i-Iqbāliyya.* A considerable portion of the

Nafahāt consists of extracts from a work which apparently is no longer extant. It was a collection of sayings and teachings of an eminent Sufic saint of the VIIIc. A.H., Ruknu'd-Dīn 'Alāu'd-Dawla Samnānī, edited by his disciple Amīr Iqbāl Sīstānī (see pp. 483 and 504). Jami often refers to it merely mentioning the name of 'Alāu'd-Daula. The title only is referred to on pp. 545, 644 and 685. As no copy of this work is accessible, it is impossible to identify Jami's borrowings in detail, but, roughly speaking, all the biographical notices 463–505 have some connection with it, perhaps also Nos. 320–323, 538, 563, whilst in the former section Nos. 469, 483, 484, are doubtful, and Nos 488–494, as we have seen, may have been extracted by Jami directly from the *Manāqibu'l-'ārifīn*. This work, *Iqbāliyya*, contains much interesting information. judging from Jami's extracts, and its recovery would be of the greatest use to students of the spiritual life of Persia.

XIII. *Laṭāif-i-Ashrafī dar biyān-i-ṭawāif-i-ṣūfī*, composed about the middle. or in the second half, of the VIIIc. A.H., in India, by Niẓāmu'd-Dīn Gharīb Yamanī, a disciple of Sayyid Ashraf Jahāngīr Samnānī (d. *circa* 840 A.H./1436 A.D.), and based chiefly on the sayings and the instruction of this saint.[1] This bulky work contains a great deal of biographical material, usually based on the works of Yāfi'ī, Ibnu'l-'Arabī. even Anṣārī's *Ṭabaqāt*, and perhaps on some other sources which have not come down to us. It is impossible to be certain that Jami really used this book, because he does not mention its title or the author's name. But there is an important section, Nos. 565–577, dealing with the biographies of the famous Persian Sufic poets, the text of which, on collation, *literally* corresponds to the portion of *Laṭāif*, dealing with the same subject.

As no earlier work, from which these biographies may have been taken by both, can be suggested at present, the only conjecture which remains is to think that Jami really borrowed them from Niẓāmu'd-Dīn Gharīb.

Besides these principal sources Jami probably perused occasionally the material found in the well-known Arabic works on Sufism. But sometimes he gives extracts from some rarer books, such as the *Kitābu'l-anwār fī kashfi'l-asrār* of Shaykh Rūzbihān al-Baqlī (p. 288), as well as from compositions of other writers, 'Izzu'd-Dīn Muḥammad Kāshī (whose whole biography, No. 503, consists apparently of quotations from his own works), and Sayyid 'Alī Hamadānī (in his biography, No. 478).

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[1] See Rieu, Catalogue of the Persian MSS, vol I, p. 412. He mentions only extracts from this work, on page 1042, but complete MSS. of it exist in the library of A.S.B. (E 166) and in the Būhār collection, Imperial Library, Calcutta (No. 175 of the Catalogue).

The notices on some early Sufic saints of the Chishtī affiliation in India (Nos. 513 and 514), if not taken from the *Laṭāif-i Ashrafī*, are perhaps derived from some early work of Indian origin.

There remain a number of biographies, about whose origin nothing definite can be suggested. Most probably all of them are taken from the sources enumerated above, but were either placed out of their context, or had their wording much changed by Jami who did not trouble to mention his authorities Such are Nos. 20, 21, 31, 34, 37, 38, 41, 77, 79. 129, 154, 171, 185, 205, 383, 384, 393, 428 (probably taken from the works of Ibnu'l-'Arabī, Yāfi'ī and Hujwīrī, or from the same sources as those of the biographies of Abū Sa'īd and Aḥmad-i Jām). Nos. 515 and 539 I cannot trace at all. Nos. 551–558 may be either direct borrowings from Yāfi'ī, or may have been taken from *Laṭāif-i-Ashrafī* and altered in the wording.

(NOTE.—No. 433 in the Nassau-Lees' edition is a mistake, it is merely a continuation of No. 432. The separate biographies, omitted here, are found in other editions, Nos. 389 *bis* and 468 *bis*. The first probably belongs to the same source as that of the group of Aḥmad-i-Jām's associates, the second is apparently due to Jami's own pen.)

ADDENDA.—(*a*). To p. 385. Another copy of Anṣārī's *Ṭabaqāt* is in the possession of the Nūrī 'Uthmānī libr. at Constantinople, No. 2500. It is dated 839 A H., but seems to be not as correct as the A.S B 's copy. Cf. L. Massignon, La passion d'al-Hallaj, 1922, vol. II, Bibliographie, No. 1059. A page of its text is reproduced, ibid. vol. I, plate XIII (on p. 368).—(*b*). To p 388. There was yet another work on the early Naqshbandīs, comp. towards the end of the VIIIc. A.H. by Ṣalāḥ b. Mubārak Bukhārī, i.e. *Anīsu't-ṭālibīn wa wa'datu's-sālikīn* (Ethé, Cat. Pers. MSS. in India Office libr., No. 1851; also MS. A.S.B., E 23;.—(*c*). To p. 390, note 1. Other copies in Constantinople libraries: 'Āshir Efendī, 677; 'Umūmī, 157; see L. Massignon, op cit., vol II, Bibliographie, No. 170.—(*d*). To p. 400. There was yet another revised edition of the *Manāqib*, i.e. *Thawāqibu'l manāqib-i awliyāi'l-lah*, prepared in 947/1540 by 'Abdu'l-Wahhāb Hamadānī (see Ethé, op. cit., No. 631).

28. An Ismailitic Pedigree.

By W. Ivanow.

A manuscript in the collection of the Asiatic Society of Bengal, marked Na 106 (or old No. 319), contains a rare Persian work, in *mathnawī* verse, with the title *Lama‘ātu’ṭ-ṭāhirīn*, composed in 1108 A.H /1697 A.D.[1] The copy itself was probably also transcribed about the same time, i e. the beginning of the XIIc. A.H., and is still in fairly good condition

The work contains an exposition of the system of Shi‘ism. It is extremely lengthy (about 500 folios), and, at the same time, as remarkably dull as verbose, consisting of a real deluge of words in flowery combinations, but with very little tangible sense or ideas behind them It is divided into a prose introduction and 110 *lama‘as* (to correspond to the numerical value of the letters of the name ‘Ali). It would require too much space to reproduce their headings here. The poetical author has given them a very rhetorical and bombastic form so that many of them are monstrously inflated, occupying no less than half a page.

The author, Ghulām-‘Alī b Muḥammad-‘Alī b. Aḥmad (the latter apparently being surnamed *Tūām*). a native of the Deccan, as can be gathered from his allusions, used the *takhalluṣ* Ghulām or Ghulāmā I have not been able to trace him in any work, accessible to me at present, dealing with the biographies of Indian poets Most probably the author's poetical activity was of a purely accidental nature. and the production of his book was primarily an act of piety. At all events his persistent desperate struggle with verse does not show any great poetical talent.

The Shi‘ite principles, expounded in the work, have a strong flavour of sectarian tendency Here and there they recall the dogmas of Ismailism, but such passages are always very elusively worded In addition to this the author has made much use of the Sufic speculations—a popular device of all the 'heretical' writers of the later period.

Not content with this, the author also makes extensive use of the principle of *taqiyya*, which allows one to pretend outwardly to comply with the teaching of another sect or religion by way of precaution intended to frustrate the suspicions of persecutors.[2] This is apparently the reason not only for lengthy and exaggerated eulogies of the first three caliphs (Abū Bakr, 'Umar and 'Uthmān, much hated by all Shi'ites, even the most moderate), but also, strange as it may seem, for the direct dedication of his work (which is clearly of suspicious orthodoxy), to the fanatical Sunnite ruler Aurangzib (f. 2v. and the whole of the 78th *lama'a*), who, one has reason to think, could hardly be much pleased with this unsolicited token of his subject's affection.

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[1] Expressed by a chronogram لمع عشق نوامان.

[2] See in this connection an important article by the late I. Goldziher, Das Prinzip der Taḳijja im Islam, ZDMG, 1906, pp. 213-226.

The work itself would for these reasons hardly deserve much attention. But at the end of this copy there is added a pedigree of a saint, Sayyid Shāh Mīr Muḥammad Musharraf, apparently the author's spiritual guide. This postscript is in the same handwriting as that of the whole of the volume, and many allusions to various ancestors of the saint are to be found throughout the text. Therefore there is no doubt as to their internal connection, and it is very probable that this pedigree dates from the same period as that in which the book was composed, i.e. the end of the XI or beginning of the XII c A H. On examination the pedigree proves to be of Ismailitic origin, and follows the main line of the Imams as far as the fall of the Alamut dynasty.

In my previous publication on Ismailism,[1] I discussed the question of the importance which may be attached to the traditional sectarian version of the 'chain' of their Imams. Our information about it is as insignificant as about other points of the history of the movement, and therefore every chance of shedding some additional light on it cannot be welcomed too warmly. In the present case the information is especially valuable, because our document shows what the tradition was some 250 years ago. At the same time we have every reason to be sure that the version represented here can be only traditional The descent from the heretical rulers of Alamut would not appeal to any non-sectarian. But if the pedigree was intended to command the respect of the Ismailitic community, it would be not only unwise, but perhaps even incompatible with the sanctity of the tradition, to introduce a new version.

In order to save space as much as possible, I will take here for granted the acquaintance of the reader with the contents of my 'Ismailitica,'[2] and I will only point out the divergencies between that, modern, version, and this. older one, in the present pedigree.

As usual in documents of this kind, the persons are enumerated here in the *ascending*, genealogical order: so-and-so, son of so-and-so, son of so-and-so, etc. The pedigree, which is called here *kursī*,[1] traces the origin of the saint in question up to Adam, but I omit, for the sake of brevity, all the legendary ancestors before 'Alī, and give the names in the reverse. *descending* order.

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[1] Ismailitica, I-II, Memoirs of the Asiatic Society of Bengal, vol. VIII (1922), pp. 58-73.

[2] See the preceding footnote.

The generations 1-5 are the usual: 'Alī, Ḥusayn,[2] Zaynu'l-'Ābidīn, Muḥammad Bāqir, and Ja'far Ṣādiq (the latter with the epithet *Imām-i-Nāṭiq*). No. 6 is Isma'īl, called here *Imām-zāda*. No. 7—Muḥammad, called *as-Sābiḥ* (?—not very legible). The next three generations, corresponding to the first 'dark period.' are: No. 8—Aḥmad ar-Raḍī (or Riḍā ?), instead of Wafī Aḥmad of the modern version: No. 9—Muḥammad at-Taqī, as usual; No. 10—Aḥmad al-Kūfī, instead of Raḍī 'Abdu'l-lah. The latter name is an obvious variant for al-Wafī, because they can be very easily confused in careless handwriting. Which is correct, it is difficult to say. Besides. it seems quite possible that Nos. 8 and 10 are transposed either in the old or in the new version, and there may be little doubt as to their identity in both pedigrees.

The members of the Fatimide dynasty are enumerated in their usual order, although their names are particularly badly misspelt or entirely wrongly reproduced. No. 11—'Abdu'l-lah (for 'Ubaydu'l-lah) Mahdī[3]; No. 12—Muḥammad (for Aḥmad) al-Qāim; No. 13—Mawlānā Isma'īl al-Maghribī[4]; No. 14—Mawlānā Mu'izzu'd-Dīn (for Mu'izz li-dīni'l-lahi) · No. 15—Nizār[5]; No. 16—Mawlānā Ibrāhīm[6]; 17—Mawlānā 'Alī az-Ẓāhir (here by mistake Ṭāhir): No. 18—Mawlānā Muḥammad, surnamed (as stated in a gloss) Shāh Ḍiyāu'd-Dīn. This name is obviously misplaced. and if it belongs to the pedigree at all. probably pertains to the period after the Khudāwands of Alamut. No. 19—Mawlānā Mustanṣir (here wrongly Mustanẓir)[7]. No. 20—Mawlānā Nizār.

Next comes another 'dark period,' which preceded the rise of the Alamut dynasty. The original text at the scribe's disposal was probably also not good. No. 21—Mawlānā Aḥmad al-Munẓir (sic ?—perhaps for al-Muntaẓar ?).[8] As in the preceding 'dark period' the order of the three names may be confused; No. 22--Mawlānā 'Alī al-Hādī (he stands nowadays first of the three); No 23—Mawlānā Muḥammad al-Muhtadī (probably a variant to the modern Muqtadī). It is remarkable that while the names do not coincide completely with those in the modern version, the number of generations remains the same

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[1] This is an abbreviation of *kursī-nāma*, both very common terms amongst the sectarians and darwishes. It can be translated: ('list of those who occupied) the throne.'

[2] Ḥasan, as at present, not included in the pedigree as not a parent of other Imams in this line.

[3] A gloss: Mawlānā Muḥammad Mahdī.

[4] i.e. al-Manṣūr.

[5] Sic, without the title 'Mawlānā.' He is usually known as al-'Azīz

[6] Judging from his position, he must be al-Ḥākim. Abū 'Alī Manṣūr In a gloss he is called al-Manṣūr bi-amri'l-lahi Ta'ālā.

[7] A gloss: 'Alī al-Ḥāfiẓ (this was an altogether different prince, 524-544 A.H./1130-1149 A.D.).

[8] In the modern version this place is occupied by Shāh Qāhir. There is a gloss: Ḥalālu'd-Dīn obviously for Jalālu'd-Dīn.

The names of the Khudāwands of Alamūt are given in the correct order although some of them are not accurately reproduced: No. 24—Mawlānā Ḥasan al-Qāim; No. 25—Kiyā (الكيا sic !) Muḥammad; No. 26—Jalālu'd-Dīn Ḥasan (with the epithet *Kabīr* here); No. 27—Mawlānā 'Alāu'd-Dīn (here 'Aliyyu'd-Dīn) Muḥammad: No. 28—Mawlānā Maḥmūd (sic) Khūrshāh.

Then follows an entirely unknown period. From the difference in the names found in both versions it is fairly certain that we have two different lines of the family. But where these two branches become separate one from the other is difficult to determine. I feel almost sure that at least two generations are identical, i.e. No. 29—Aḥmad al-Qāim, which may be a variant of Qāsim in the modern version, as well as No. 30—Shāh Khūrshāh, with a gloss 'surnamed Shams-i-Tabrīz,[1] probably the same as Shamsu'd-Dīn of our contemporaries.

The remaining 9 generations are: No. 31—Muḥammad-Shāh; No. 32—Ibrāhīm Mu'min-Shāh; No. 33—Shāh Ṭāhir[2]; No. 34—Shāh Raḍiyyu'd-Dīn 'Alī[3]; No. 35—Shāh Ṣadru'd-Dīn Muḥammad; No. 36—Shāh Khudābakhsh; No. 37—Shāh 'Azīz; No 38—'Abdu'l-'Azīz, 'who after the death of the blessed saint, his father, lives (adorned with) glorious qualities'; No. 39—Sayyid Shāh Mīr Muḥammad Musharraf.

Thus we have in all 38 generations (No. 18 is out of place and it is difficult to find whether it belongs to the pedigree at all) This agrees fairly well with the 'pace' of the modern version containing 48 names; the difference of 10 generations is in agreement with a period of 250 years.

It is not my intention to undertake special research for identification of the person of the saint whose pedigree is here discussed, or of the locality in India where he lived and was worshipped Perhaps some one else interested in this field of Indian antiquity may care to attempt literary 'excavations' in this direction. And I feel sure that such research might lead to finds of exceptional interest.

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[1] This popular, and at the same time very mysterious saint, as I have pointed out already in my other publications, is always connected in the popular legends with the Ismailitic movement. He is especially worshipped by the darwishes of Persia and India.

[2] A gloss: قدوة السالکین حضرت شاه طاهر مشهور نور الله مرقده.

[3] A gloss: Ḥaydar.

29. Contributions to the History and Ethnology of North-Eastern India—IV.

By H. E. STAPLETON, I.E.S., *Special Officer, Dacca University*

BENGAL CHRONOLOGY DURING THE PERIOD OF INDEPENDENT MUSLIM RULE.

Part I, 685-735 *A.H.* (1286-1334 *A.D.*)

Shortly after the issue, in 1911, of the first Catalogue of Coins in the Shillong Cabinet the writer had the singular good fortune for a numismatist of discovering a Muhammadan cultivator at Singsrī, on the Lakhya River, north of Dacca District, who was in possession of a large number of mediaeval Bengal coins. Among the coins that he produced when I first visited his village was one of the hitherto almost unknown Hindu King Danujmarddana (*c.* 1416 A.D.); and in consequence of winning his confidence at our first interview, the man gradually got into the habit of bringing me coins to select from whenever he found himself in want of ready cash. In this way, within two or three years, a very representative series of Bengal coins of the 8th and early 9th centuries of the Hijra was accumulated, and, in 1914, I felt myself in a position to carry out for at least this period of Bengal history the same sort of survey that I had made in 1910 for the history of Assam from 1543 A.D. to the advent of British rule Not only was my own collection available, but there had been important finds of coins of the same period at Enāyetpur, Mymensingh in 1909; at Purinda, Dacca, in 1910; at Rupaibāṛī, Nowgong, in 1911; and at Kastabir Mahalla, Sylhet, in 1913; all of which were then uncatalogued The war, however, intervened; and I was only able, before leaving India, to describe a few coins of the same provenance as my own in the *Dacca Review* for April, 1915

On my return to India at the end of 1919 I found that the enforced delay had not been without a large degree of compensation. In the interval, a supplement to the Shillong Catalogue had been published; and further interesting finds of mediaeval Bengal coins had been made at Rautkhai (Sylhet) 1914, Khulna District in 1915, Kankaribāgh (Sylhet) 1916, Bashail (Sylhet) 1917, and Murapārā (Dacca District) in 1919. To some extent I even found myself forestalled by a discussion of the Murapārā find that obtained for its author (Babu Nalini Kanta Bhattasālī, M.A., Curator, Dacca Museum) one of the Griffith prizes of the Calcutta University in 1920; and

I am glad to acknowledge, to begin with, that his careful description of the Murapārā coins has been of much assistance to me in discussing the period covered by these particular coins I regret, however, I cannot agree with many of his conclusions (especially when he bases them on unwarranted criticism of Mr. Thomas' pioneering work on Bengal numismatics); and as, in the cases of most of the Kings concerned, independent material is now available on which a complete historical analysis of a considerably longer period than the Curator of the Dacca Museum dealt with can be based, I am in a position to carry out the survey of the field that I was on the point of making in 1915 with even greater prospect of arriving at the truth than I could have hoped for six years ago.

Before passing on to the paper, I should also like to acknowledge the generous assistance that I have received from all custodians of national and provincial collections of coins that it was necessary for me to consult. Mr. J. Allan. of the Department of Coins and Medals at the British Museum, besides supplying me with casts of an important coin that does not seem to have been previously noticed, afforded me free access to the Bengal coins in his charge: Dr D. R. Bhandarkar and Monsieur A. Foucher, Superintendents of the Archæological section of the Indian Museum, allowed me to check the readings of all the Bengal coins in the Indian Museum cabinet; while the courtesy of Mr. A. W. Botham, C.I E., Chief Secretary to the Government of Assam, as well as that of Monsieur Foucher, has enabled me to reproduce several important coins in Plate X. The opportunities I was given by these gentlemen of re-studying every Bengal coin included in the Indian Museum and the Shillong supplementary Catalogues will sufficiently explain the *variæ lectiones* in the case of certain coins already published. I would also mention in conclusion that I am indebted to Babu Nalini Kanta Bhattasālī for the excellent photographs of the coins given in Plate X.

THE BALBANĪ KINGS OF BENGAL.

Nāṣiruddīn Maḥmūd, c. 682–690 *A.H.*

The annals of independent Muslim rule in Bengal are usually taken to commence with the reigns of Fakhruddīn Mubārak and his rivals 'Alī Shāh and Ilyās Shāh, but except for the incidents that led to the extinction of the earlier line of Balbanī Kings and the temporary re-appointment of Governors by the Dehlī Sulṭān Muḥammad ibn Tughlaq between 725 and 735 A.H., there is nothing to distinguish the status of the Balbanī Kings from that of the Muhammadan (and Hindu) Kings who ultimately succeeded them. I therefore propose to begin with a survey of the numismatic and other evidence that now enables us to fix the chronology of the Balbanī Kings with a fair degree of accuracy.

The immediate cause of the establishment of the first descendant of the Dehlī Emperor Balban, as ruler of Bengal, was the successful suppression by Balban of the insurrection of Tughril. a favourite slave whom he had made Governor of Bengal. About 680 A.H. Tughril had become very powerful, owing to the booty he had obtained from a successful intervention in the affairs of the independent Hindu Kingdom of Tipperah, and had been induced to declare his independence under the title of Sulṭān Mughīṣuddīn.[1] Two generals who were sent against him by Balban were defeated, but when finally, about 682 A.H., Balban in person took the field Tughril was slain on the borders of Tipperah. After savage retribution had been made in Lakhnautī on Tughril's adherents, Balban returned to Dehlī leaving Bengal in charge of his younger son Maḥmūd, commonly known as Bughrā Khān, who was invested at the same time by his father with many of the insignia of regal power. Four years later Balban died, having previously nominated Kai Khusrū, the son of his deceased elder son, as his successor at Dehlī. The nobles then in power about the throne preferred, however, a son of Bughrā Khān called Kaiqubād, whom they made Sulṭān with the title of Mu'izzuddīn. This led Bughrā Khān to declare his independence in Bengal with the title of Nāṣiruddīn, and he even made a faint-hearted attempt to claim the throne of Dehlī by force of arms He was ultimately, however, persuaded to return to Bengal without fighting, nor did he even take any active steps to revenge the death of his son. two years later, in 688, when Kaiqubād was assassinated and Jalāluddīn Khiljī became Sulṭān of Delhī in his stead.

All this we know from the narration of Ziāuddīn Baranī;[2] -but in spite of Baranī's assertion that, on the accession of Kaiqubād. Maḥmūd struck coins, bearing his newly assumed title of Nāṣiruddīn, neither coins nor inscriptions in the name of Nāṣiruddīn have yet come to light, and thus, for historical purposes, this King must remain for the present almost a cypher. The only fact that corroborates Baranī's account is that Maḥmūd's son, Kaikāūs, by using on his coins (as well as in one of the mosque inscriptions of 697 A.H. noted below) the title Al Sulṭān ibn Sulṭān ibn Sulṭān implicitly claims independent rule for his father. Ibn Baṭūṭah states[1] that Nāṣiruddīn died in Bengal "some years after" his visit to his son Mu'izzuddīn in 686 or 687. We may therefore reasonably assume the minting of coins by Kaikāūs in 690 shows that the death of Nāṣiruddīn occurred either in the same or the preceding year.

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[1] Babu Kailash Chandra Singha, on pp. 30–31 of his *Rājamālā* (a history of Tipperah, compiled from local records: printed in 1303 B.S. = 1896 A.D.), states that Tughril's reason for invading Tipperah was to support Ratnafā (the exiled youngest son of Mahārājā Dungurfā of Tipperah) against his eldest brother Rājāfā, who had succeeded his father on the throne. Rājāfā was slain in battle, and when Ratnafā ascended the throne he presented Tughril with a *Vek-Mani* (Jewel from a Frog's head) and 100 elephants. In return Tughril conferred on him the title of Mānīkya, which the ruling Princes of Tipperah have ever since borne

[2] Elliott and Dowson, *History of India as told by its own Historians*. III, pp. 112–122.

Ruknuddīn Kaikāūs (690–701 *A.H.*).

The first coins known to have been struck by a member of the Balbanī line of Kings in Bengal appear with the accession of Ruknuddīn Kaikāūs, possibly in 690 A.H. This date is to be found on Bengal coin No. 8 of the Indian Museum Cabinet, the marginal inscription of which has been completely misread. The inscription (*vide* Pl. X. fig. 1) runs as follows :—

ضرب هٰذه الفضه [بحضرت] لكهنوتي من [or في] خراج بنگ سنه تسعين وستمايه

"This silver (coin was) struck at [Ḥaẓrat] Lakhnautī from (?) the land-tax of Banga in the year 690."[2] Besides the unique date, the coin is valuable for the first mention on a Muslim inscription of BANGA as the name of the whole or part of Bengal. It may also indicate the final incorporation under Muslim rule of the territory in Eastern Bengal held by Hindu rulers, one of whom, Danuj Rai of Sunargaon, is mentioned as having assisted Balban a few years previously against Tughril by agreeing to prevent the latter escaping by water.[3]

Historians omit all mention of Kaikāūs, but from the titles he uses on his coins as well as the mention of Maḥmūd on one inscription as his father (*vide infra*), it is certain that he was a son of Nāṣiruddīn. Coins of Ruknuddīn struck at Lakhnautī in 69[3?], 697, 698 and 69[9?], which were unearthed in 1910 at Purinda, Dacca District, are preserved in the Shillong Cabinet[1]: and the Indian Museum Cabinet also includes coins of 691 and 697 from the same mint. The only two mosque inscriptions that bear the name of Kaikāūs are both dated 697 A.H. In the one at Gangarāmpur, Dinājpur (the old Hindu stronghold of Dev-Kot[2]) he is described as Kaikāūs S̱hāh, son of Maḥmūd, son of the Sulṭān (i.e. Balban). In that from Khagol[3] the titles run " Shah, the Sultan, son of a Sultan, son of a Sultan."

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[1] Defrémery and Sanguinetti's translation, III, p. 179.

[2] Other examples of the phrase *min kharāj* (and some place name) on coin inscriptions may be seen in *I.M.C.* Vol II, Part I, No. 39 (an undated Altamsh—607–633 A.H.; Qanauj and Mint Bilādu-l-Hind); and *I.M.C* Vol. II, Part II, No. 6 (Mughīsu-d-dīn Yuzbak of Bengal 653 A.H ; Nūdia and Gar (?) . . ; Mint Lakhnautī). It does not follow, as Mr. R. K. Banerji assumed on p. 288 of *J.A.S.B.* for 1913, that such a legend necessarily implies that the coins were struck to commemorate the conquest of the place mentioned (*cf.*, e.g., the date on this coin of Ruknuddīn, and that of Jalāluddīn (709) mentioned later). It is impossible also to agree with his reading of Bardan as the name following *Gar* in Yuzbak's coin (*vide* reproduction in Pl. I of same Vol. of *I.M.C.*).

[3] Elliott and Dowson, *op. cit.*, III, p. 116. The Sirkār of Sunārgānw in Akbar's time included Bikrampur and much land to the south (*vide* '*Aīn-i-Akbarī*, Blochmann's trans., Bk. III, pp. 138 and 139); and as Akbar's Sirkārs in all probability represent older administrative divisions, the chief seat of the Rai may have been Bikrampur. If so, he was very probably a descendant of the Sen Kings. Minhāj records that Banga, up to the date he brought his history—the *Tabaqāt-i-Nāṣirī*—to a close (658 A.H.) was still under the descendants of Rai Lakhmāniah (Lakshmān Sen), *vide* Raverty's trans. p. 558.

S̱hamsuddīn Fīrūz (701–722 *A.H.*).

Ruknuddīn Kaikāūs was succeeded—probably in 701—by his brother S̱hamsuddīn Fīrūz. The latter's relationship to Nāṣiruddīn is given by Ibn Baṭūṭah,[4] but in contrast to the more elaborate title adopted by Ruknuddīn, S̱hamsuddīn contented himself on his coins with the simple *Al Sulṭān*. His son Ḥātim K̲h̲ān, Governor of Bihār in 709 and 715, also uses this title in referring to his father on inscriptions. The Shillong Cabinet include Lakhnautī coins of 701,[5] 702 (Purinda find) 703 (from Enāyetpur, Mymensingh), 704, 706, [70]7, [70]9, 710, 71[1?], 712, 713, 714, 715, and also 720 (Purinda). Sunārgānw coins of 705 and 710, also occurred in the Purinda find, and a new mint *Banga* is found on a coin in the Shillong cabinet from Rupaibāṛī in Nowgong (Assam).[6] Only the mint figure [- -]5 is legible on this coin, but as the position of the unit seems to leave no space for a decimal the date is almost certainly 705.

The period was one of active expansion of Musalman dominion in Bengal and the adjacent countries. The clearest picture of this is seen in the conquest of the previously independent territory of Satgānw by the Turk, K̲h̲ān Muḥammad, Zafar K̲h̲ān G̲h̲āzī, as described in 1847 by Mr. Money[7] from the 'Khurseenamah' of Zafar K̲h̲ān's descendants at Triveni near Hughli. Zafar Khan, accompanied by his sister's son S̱hāh Ṣūfī, or Ṣafī, (who appears to have been also the nephew of Fīrūz S̲h̲āh) came to Bengal from Manrgaun in Birbhum, for the purpose of converting infidels to the Muhammadan faith. The ostensible reason is given by the following local story collected by Mr. Money. A Mahomedan subject of a Hindu Raja on a certain festival in honour of his son used cow's flesh. The Raja slew the son. The father resorted to the Court of Delhi (*sic!*) and told his tale to Feruze Shah, who immediately sent an army to Bengal against the Raja, commanded by Zafir Khan, and his nephew Soofee Khan. The Raja's name was Bhoodev Nripati (i. e. King) with whom a battle was fought at a place called Mahanad, near Satgram, about 8 miles west of Triveni, where Zafir Khan's army was victorious.

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[1] The reading 7[- -] on S.C 1/5 is so extremely doubtful that I have omitted to mention it. The coins of 697 and 698 are the latest certain dates up to now known. Thomas, (*op. cit.* p. 46) only records coins of 691–695.

[2] Blochmann, *J.A.S B.*, 1872, p. 103.

[3] *Idem*, *J.A.S.B.* 1873, pp. 247–8. This place is near Lakhiserai in Bihar. (*Idem*, *J.A.S.B.*, 1874, p. 288).

[4] *Op. cit.* III, p. 210.

[5] *Vide* Pl. X. fig. 2.

[6] *Vide* Pl. X, figs. 3 and 4.

[7] D. Money, *J A.S.B.*, 1847, p. 395; (*vide* also Blochmann's account of the Triveni inscriptions in the *J.A.S.B.* for 1870).

The story is obviously a muddled one, for the first invasion of Satgānw must have been in the time of Kaikāus, as Zafar K̲h̲ān erected a mosque at Trivenī in 698 A.H.; but apart from the fact that there was no Dehlī Sulṭān of the name of Fīrūz at the time[1], Zafar K̲h̲ān's subsequent subordination to S̲h̲amsuddīn Fīrūz S̲h̲āh of Bengal is shown by the appearance of this Sulṭān's name on the memorial tablet on the Madrasah erected by Zafar K̲h̲ān at Trivenī in 713. The more reliable Khurseenāmah goes on to say that having made a proselyte of Rājā Man Nripatī, Zafar K̲h̲ān was killed in a battle fought with Rājā Bhoodev at Hughli. His head was left on the field and his body buried at Trivenī. His death, according to Mr. Money, occurred in the same year 713 as Zafar K̲h̲ān erected the Madrasah already referred to. The Khurseenāmah further states that 'Ugwhān K̲h̲an, son of the aforesaid Shah Zafir Khan Ghazee, having marched against the Raja of Hugli in Sircar Satgram, conquered him, converted the infidels to Mahomedanism and married his daughter. After some time Ugwhan Khan also died at Triveni.'

Thus Satgānw passed into Musalman hands; and in Baranī's account[2] of Muḥammad ibn Tug̲h̲laq's relations with Bengal for the few years following 725 we find it mentioned as one of the three recognized divisions of Bengal. The other two Sirkārs were Lakhnautī, the original principality acquired by Bak̲h̲tiyār K̲h̲iljī in 1198 A.D., and Sunārgānw, which, as we see from the Shillong coin of 705 was definitely included in Muslim Bengal by that date, and may, from the occurrence of the name BANGA on Ruknuddīn's coin of 690, have been finally conquered soon after Balban's invasion of Eastern Bengal in 682.

Now it is curious that precisely the same story for the invasion of a Hindu kingdom by Musalmans occurs in local

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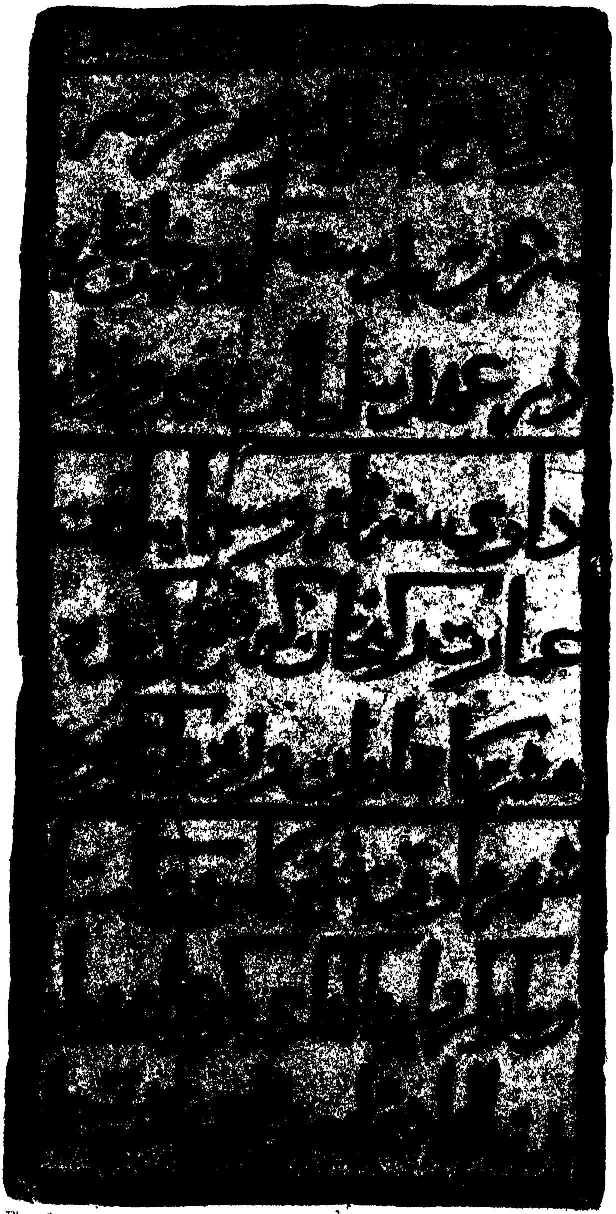
[1] Alāuddīn Muḥammad S̲h̲āh was on the throne of Delhī from 695–715.

[2] Elliot, III. pp. 236 and 239.



Photogravure

Survey of India Offices, Calcutta, 1923.

INSCRIPTION FROM SYLHET, RECORDING THE DATE OF THE FIRST MUSLIM CONQUEST OF THAT COUNTRY (703 A.H.)

tradition regarding the first conquest of Sylhet. This has previously been believed to have taken place in 786 A.H., though the name Shamsuddīn as the reigning King of Bengal at the time and the fact that one of the chief participators (Shāh Jalāl) was a disciple of Nizāmuddīn Auliya, who died in 725 A.H., might have suggested to Blochmann that the date was erroneous. That the conquest of Sylhet took place in the time of Shamsuddīn Fīrūz Shāh is practically certain from an inscription from Sylhet (now in the Dacca Museum) which was first mentioned by me in a paper contributed to the *Dacca Review* in August 1913. Though not a contemporaneous record it gives almost certainly (both from the date as well as from internal evidence) a truer version of the first invasion of Sylhet than local tradition has hitherto supplied us. The inscription (Pl. IX) runs as follows:—

بعظمت شيخ المشائخ [؟] مخدوم شيخ جلال مجرد بن محمد

اول فتح اسلام شهر عرصه | سريهت بدست سكندر

خان غازي | در عهد سلطان فيروز شاه | دلوي

سنه ثلث و سبعمايه اين | عمارت رکنخان که فتح

کننده | هشت کامهاريان وزير و لشکر بوده | شهرها

وقت فتح کامرو و کامتا | و جازنگر و اريشا لشکري کرده

باشند جابجا | بدنبال بادشاه سنه ثمان و عشر و تسعمايه .

"In honour of the greatness of the respected Shaikhu-l-Mushāikh (?) Shaikh Jalāl, the hermit, son of Muḥammad.

"The first conquest by Islām of the town 'Arṣah Srīhat was by the hand of Sikandar Khān Ghāzī in the time of Sulṭān Fīrūz Shāh De[h]lavī in the year 703.

"This building (has been erected by) Rukn Khān, the conqueror of Hasht Gamhārīyān, who being Wazīr and General for many months at the time of the conquest of Kāmrū, Kāmatā, Jāznagar and Urīshā, served in the army in several places in the train of the King. (Written) in the year 918."

The excellent state of preservation of this inscription is due to the fact that (like the inscription of Shamsuddīn Fīruz Shāh's son, Hātim Khān, of 715), the back was subsequently used for another inscription (that of a certain Masnad-i-'Alī Khān in 996.) The trustworthiness of the statement made in the first portion of the inscription is shown by the following considerations:—

(1) Sulṭān Firūz Shāh was actually on the throne of Bengal in 703 A.H.

(2) As the grandson of Ghiyāṣuddīn Balban he is rightly called Dehlawī (cf. also the connexion of Fīrūz Shāh with Dehlī in the Satgānw tradition).

(3) The date is in agreement with a local tradition that when Sikandar G͟hāzī at first failed to defeat Rājā Gour Govinda, Saiyid Nāṣiruddīn Sipahsālar, accompanied by S͟hāh Jalāl and other warrior saints, came to assist him and that the former was a General of Fīrūz S͟hāh Dehlawī.

(4) In 703 the Sulṭān of Dehlī was 'Alāuddīn K͟hiljī, which agrees with another tradition mentioned in Nāṣiruddīn Hydar's History of Sylhet (the *Suhail-i-Yemen*) that he was the Dehlī Emperor when Sylhet was conquered.

A village of the name Sekandarnagar in south-eastern Mymensingh may possibly owe its name to Sekandar G͟hāzī, but he is apparently buried at Bishgānw (*alias* G͟hāzīpūr) in the extreme south-east of the Habiganj Sub-Division of Sylhet (in the Tipperah Hills), where his shrine is venerated by Muhammadans and Hindus alike. Before coming to Sylhet he is said to have warred successfully against a Hindu Rājā of the Sunderbans called Matuk, and it is curious that the present Magistrate of Mymensingh (Mr H. C. French, I.C.S.) possesses a coin of S͟hamsuddīn Fīrūz S͟hāh dated 710 (or 720) which was found in a village in the extreme south of the Satkhīra Sub-Division of Khulna District.

The Ruknuddīn of the inscription was a well-known General of Sulṭān Ḥusain S͟hāh of Bengal (899–925 A.H.), and his name occurs on two other inscriptions deciphered by Blochmann, who wrongly makes him an inhabitant of Sarhat in Birbhum, instead of a Sylhetī.[1] The historical bearing of the rest of the inscription will be discussed later in this paper when dealing with the chronology of the Ḥusainī Kings of Bengal.

It will not be out of place here to make a few remarks on the probable attitude of the K͟hiljī Sulṭāns of Dehlī, who were contemporary with Kaikāūs and S͟hamsuddīn Fīrūz, towards these Kings of Bengal, who, by their descent from Balban, must obviously have been regarded with jealous—if not anxious—eyes. The facts mentioned by Baranī[2] that 'Alāuddīn was himself contemplating an invasion of Bengal just before he succeeded to the Dehlī throne by murdering his uncle in 695; and that again about 698 he thought of sending Zafar K͟hān (a minister whom he had begun to fear) against Lakhnautī, suggest that the presence of numerous 'saints' and 'g͟hāzīs' in Bengal at this time might even have been due to some definite policy on the part of the Dehlī sovereign. This idea is supported to some extent by Feris͟htah's remark that S͟hamsuddīn's son Bahādur S͟hāh was "an officer of the reign of 'Alāuddīn K͟hiljī"; by which it seems to be meant that he was encouraged by 'Alāuddīn in the successful attempt that will be soon referred to share the prerogatives of royalty with his father. The despatch by 'Alāuddīn's predecessor Jelāluddīn Fīrūz Shāh Khiljī of boat-loads of undesirables into the Lower Country to the neighbourhood of Lakhnautī where they were "set free so as not to trouble the neighbourhood of Dehlī any longer"[1] may also be noted in the same connexion. The easiest way for the Sulṭāns of Bengal to nullify such a wholesale deportation (nearly 1000 came in one lot) was to enrol these men in a "Foreign Legion" and utilise them in warring against the infidel on the frontiers of Bengal, and this is probably what Shamsuddīn and his predecessor actually did.

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[1] *J.A S B.*, 1870, pp. 284 and 295; *idem*, 1872, p. 106

[2] *Loc. cit.*, pp. 152 and 165.

Having thus dealt with two of the expeditions of conquest that undoubtedly characterised Bengal at this period, let us return to a consideration of other events of the reign of this King, whose dominions extended from the confines of Bihār in the West to the remotest corner of Sylhet in the East, and whose reputation in Bengal is shown by the fact that, after the Governors appointed by Muḥammad ibn Tughlaq on the fall of the Balbanī dynasty had, in their turn, been swept away, we find the capital Lakhnautī appearing on the coinage under the name of Fīrūzābād. As this survey will chiefly consist of a narration of the efforts of his sons to share the sovereignty of Bengal with their father, or, after Fīrūz Shāh's death (about 722 A.H.), either with a brother, or a Governor of the Dehlī Sulṭān, a fresh section will be begun with a list of the sons of Fīrūz who are known to have struck coins

Jalāluddīn Maḥmūd	..	(709- *or* 707- *A.H.*)
Ghiyāṣuddīn Bahādur	..	(*c.* 710–728)
Shihābuddīn Bughrah	..	(717 and 718)
Nāṣiruddīn Ibrāhīm	..	(*c.* 724–726)

By 709 A.H., when we find Hātim Khān, a son of Fīrūz Shāh, installed as Viceroy to his father in Bihār[2], Shamsuddīn must have completely consolidated his power, and in the same year (or, possibly, two years earlier) we find another son Jalāluddīn Maḥmūd, permitted by his father to strike coins at Lakhnautī[3] Except for a mention of his unique coin in the Shillong Supplementary Catalogue (p. 106), this son has hitherto been unknown to history, and the margin of the coin is incorrectly given in the Catalogue From the reproduction of the coin in Pl. X, fig. 5, it will be seen that although the marginal legend is not very distinct, it is probably the same

as that already noted for I.M.C. No. 8, except that the date is either 709 or 707. The translation of the margin runs:

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[1] *Idem*, p. 141.

[2] Blochmann, *op. cit.*, 1873, p. 249.

[3] The name Maḥmūd furnishes a certain amount of evidence that he was the great grandson of Balban, as the name of Shamsuddīn's father, Bughrā Khān, was also Maḥmūd. For this Muhammadan custom of naming a child after his grandfather *vide* Blochmann, *op. cit.*, 1873, p. 288.

"This silver (coin was) struck at *Hazrat* Lakhnautī from the land-tax of Banga in the year 709 (*or* 707)." This third mention of **Banga** on a coin legend furnishes additional evidence to that supplied by Fīrūz's coins of Sunārgānw struck in 705 and 710 of the complete subjugation of Eastern Bengal either during, or before, the reign of Fīrūz Shāh.

Jalāluddīn's success in inducing his father to share the kingly prerogative of striking coins with a son must have roused jealousy amongst Maḥmūd's other brothers, and it is not surprising to find in 710 the appearance of the coinage of another son, Ghiyāṣuddīn Bahādur (nicknamed *Būrah*, the Black one[1]) also appearing simultaneously with that of Fīrūz Shāh. The absence of any other coin of Jalāluddīn and the continuance after 710 of Lakhnautī coins of Bahādur suggests the possibility of Bahādur having succeeded in arranging for the assassination of his presumptuous brother or at least, of achieving his permanent exile from Lakhnautī.

The Shillong Cabinet includes coins struck in Bahādur's name of 710, 720, and 72[2?], from Enāyetpur. Mymensingh; 714, 717, 720 and 721 from the Purinda find; 721 from Rupaibāṛī, Assam; and 721, 722 (or 723: S C. $\frac{2}{10}$), 72 [2?] (S. C. $\frac{2}{21}$ – $\frac{2}{23}$) and 723 (S.C. $\frac{2}{20}$) found at Kastabīr Mahallah, Sylhet, in 1913. All the above, where mints can be read, are from Lakhnautī; except in the case of the 717 coin from Purinda (S. C. $\frac{2}{4}$) which was found on re-examination to have been struck at Sunārgānw. My own cabinet includes the following coins with date and mint clearly legible in the margins: 3 of 720, 4 of 721, 1 of 722, and 3 of 723. These all were struck at Lakhnautī and were bought in the vicinity of Enāyetpur. The only other Ghiyāṣuddīn coin with fairly complete margin in my cabinet that was obtained from this part of Mymensingh bears the first portion of the mint name Sunārgānw and was struck in 72[-].

There remains to be considered the extremely interesting Shillong Cabinet coin $\frac{2}{10}$ from Enāyetpur, (*vide* Pl. X, fig. 7) which was struck at *Qaṣbah Ghiyaṣpūr*. This mint has previously been recorded by Thomas from one of Col. Guthrie's coins of the Kuch Bihār find[2] but, long before the Shillong coin supplied certain evidence on the subject, I was extremely doubtful as to the accuracy of Thomas' reading 730 for the date. The margin after the mint name on Col. Guthrie's specimen was mutilated, but, even if one conceded that the following word was سنه, I could not agree with Thomas' reading of ثلاثين for the Arabic numeral 30. which, so far as I know, is invariably written ثلثين on Bengal coins. From the Shillong coin which is apparently an exact duplicate of Col. Guthrie's coin, it is evident that the date of both coins is 722, and, indeed the unit سنه اثني, in the year two, is clearly legible at the bottom of Thomas' reproduction. The reading of the marginal inscription of S.C. $\frac{2}{10}$ in the Shillong Supplementary Catalogue, besides being probably at fault in reading احدى (one) for اثنى, is also wrong in regard to the words that follow the mint name, as there is only one month of Safar in the Arabic calendar. I cannot however at present offer any certain suggestion for a correct reading, though it seems possible that the word immediately preceding سنه is صفر (Safar).

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[1] Ibn Baṭūṭah, *loc. cit.*, p. 210; Blochmann, *J.A.S.B.*, 1874, p. 289, notes that this is evidently the Hindustani بھورا "brownish." Mr. R. Burn, C.S., informs me, however, that in the United Provinces *bhūrā* is used to refer to a man who is markedly fairer than the ordinary Indian, with brown moustache, blue eyes, and a wheat-coloured complexion.

[2] Thomas, *Chronicles of the Pathan Kings*, pp. 153 and 201; and *Pl.* VI, fig. 5.

Enāyetpur lies on raised land about 15 miles south-west of the present town of Mymensingh, on the upper reaches of the Banar River that drains the centre of the Madhupur Jungle into the Lakhyā, and as a *mauza* on the river bank near Enāyetpur is still known as Ghiyāṣpūr, it seems probable that this was the site of the mint that Ghiyāṣuddīn named after himself. It is not far from the *Bāratīrtha*, a tank said to have been excavated by a Hindu King called Bhagadatta Rājā. After the tank had been dug, samples of water from 12 Hindu places of pilgrimage were poured into the tank and thus the Rājā's mother was enabled to acquire virtue by bathing therein, without actually visiting the *tīrthasthānas* herself. A large pilgrimage to the Bāraṭtīrtha still takes place annually in March.[1]

Thomas suggests that Ghiyāṣpūr is near Maldah, but if the identification of the position of this mint on the Banar

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[1] One local tradition in Mymensingh actually states that Bhagadatta Rājā lived at the time when the Muhammadans first began to conquer Eastern Bengal; and his battle with the Muhammadan King, whose name is not known, is said to have taken place near Bogra. The same story is told of him as is recorded of Rājā Ballal of Rāmpāl in Bikrampur. He took a pigeon with him when going into battle and told his Rānī that if the pigeon came home alone it would be a sign that he had been defeated. By chance, during the fight, when things were going well for the Hindus, the pigeon escaped. Bhagadatta instantly returned to his camp and mounting a swift horse galloped towards his capital: but on reaching home he found nothing but burning ashes, the Rānī, to prevent herself from falling into the hands of the Muhammadans, having set fire to the palace, and thrown herself, with her entire family, into the flames. The Rājā, being disgusted with the world, turned into a *sanyāsī*, and was heard of no more.

River, Mymensingh, is correct, the fact probably furnishes one more indication of the active extension of Muhammadan rule in Bengal during the reign of S̱hamsuddīn. In this case it resulted in the absorption either of the petty sovereignty of a Hindu Rājā (who may have fled from Bengal to the Madhupur jungle for fancied security from his Musalman foes), or of an outlying portion of the dominions of Kāmatā or Prāgjyotis̱hpūr (Assam).

G̱hiyāṣuddīn was not allowed to share the sovereignty with his father without dispute, and it was the successful attempt of another son of S̱hamsuddīn, viz.: S̱hihābuddīn Bug̱hrah S̱hāh, in 717–718 to obtain the same right of coinage as his brother that ultimately led to the affairs of Bengal again becoming of active interest to the sovereigns of Dehlī The few coins of S̱hihābuddīn previously recorded are all dated 718, but the unit decimal on a coin in my possession, which was purchased at the Calcutta mint in 1906 from among the *rejecta* of a find made at Murshidabad the previous year, seems clearly to be -17, سبع عشر.[1] As there is also a coin of G̱hiyāṣuddīn of 717 in the Shillong Cabinet and no coins struck by G̱hiyāṣuddīn in 718 or 719 are known, S̱hihābuddīn seems to have successfully ousted his brother from his position as joint ruler with S̱hamsuddīn during the year 717, and, possibly, maintained himself in power at Lakhnautī for two years longer In 720, however, G̱hiyāṣuddīn's coins begin again and are found in comparatively large numbers for each of the succeeding years until 723; in which year G̱hiyāṣuddīn's coinage as an independent King comes to an end.[2]

We only possess two fairly satisfactory contemporary authorities for this period, Ibn Baṭūṭah, the Tangiers doctor, who arrived in India at the beginning of the Hijra year 734 (September, 1333), but who dictated an account of his travels in 756, several years after his first return to Morocco: and Ziā-ud-dīn Baranī, who completed in 757 A.H. the task he had set himself of continuing the celebrated *Tabaqāt-i-Nāṣirī* from the date (658) its author Minhājuddīn had brought his work to an end. Both Ibn Baṭūṭah and Baranī need to be used with caution: but as they happen to throw considerable light on the very obscure history of Bengal from 720–750 A.H., I will now quote the passages in which these writers refer to the Balbanī Kings and the events in Bengal between the time of the disappearance of the last of these Kings, and the establishment of another independent line of Bengali Kings with Faḵhruddīn and Ilyās S̱hāh.

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[1] *Vide* Pl. X, fig. 6.

[2] The British Museum Catalogue gives one coin of 728, but on inspection the unit word was found to be undoubtedly ثنی', so that the real date of the coin is 722.

After narrating the attempted rebellion in the Deccan of of Ulugh Khān Muḥammad Fakhruddīn Jūnā against his father Ghiyāṣuddin Tughlaq of Dehlī in 721–22, and the execution by impaling at Tughlaqābād of two of the conspirators, Ibn Baṭūṭah goes on to say:[1]

"The other Amīrs fled to Sulṭān Shamsu-d-dīn, son of Sulṭān Nāsiru-d-din, son of Sulṭān Ghiyāṣu-d-din Balban, and established themselves at his Court (at Lakhnautī).

"The fugitive Amīrs dwelt with Sulṭān Shamsu-d-dīn. Soon afterwards he died, leaving his throne to his son Shihābu-d-dīn. This prince succeeded his father, but his younger brother, Ghiyāṣu-d-dīn Bahādur Būrah (this last word signifies in the Indian language *black*,) overpowered him, seized upon the kingdom, and killed his brother Katlu Khān and most of his other brothers. Two of them, Sulṭān Shihābu-d-dīn and Nāṣiru-d-dīn, fled to Tughlaq, who marched forth with them to fight with the fratricide. He left his son Muḥammad in his kingdom as Viceroy, and advanced in haste to the country of Lakhnautī. He subdued it, made the Sultan Ghiyāṣu-d-dīn prisoner, and set off on the march to his capital carrying his prisoner with him."

Baranī's account of the same incident runs as follows[2]:—

"At that time also there came certain of the chief men of Lakhnautī, and stood in the presence of the King, and told him of the tyranny and exactions of the governors of Lakhnautī, and informed him of their distress and of their sufferings, and of the complaints of all Musalmans, because of the injustice of those Governors So Sulṭān Ghiyāṣuddīn resolved within himself that he would march to Lakhnautī, and he sent messengers to Sulṭān Muḥammad, and made him come from Arankal, and appointed him Regent in his absence, and entrusted to him the affairs of the government; and himself departed with an army to Lakhnautī and crossing deep rivers, and quicksands, and swamps he hurried on his way to Lakhnautī"

"When the shadow of Tughlaq Shāh fell upon Tirhut Sulṭān Nāṣiruddīn, Governor of Lakhnautī, came with submission and obeisance to the Court and humbly offered allegiance · so that before the sword of Tughlaq Shāh was drawn, all the chiefs and the nobles[3] of that country hastened to do him service, and to offer him their obedience. Then Tatar Khān, who was the adopted son of Sulṭān Tughlaq Shāh, and was Governor of Zafarābād, was sent with an army and brought all that country to submission; and Sulṭān Bahādur Shāh,

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[1] Elliot and Dowson, *op. cit.*, III. p. 609. The spelling Tughlaq adopted in the *I.M.C.* has been followed in this paper though Tughluq is probably more correct.

[2] Mr Auckland Colvin's translation (*J.A.S.B.*, 1871, pp. 244 and 245) is quoted as it is somewhat fuller than Elliot and Dowson.

[3] *Rais* and *Ranas*.

Governor of Sunārgānw, who was rebellious, he brought with a halter round his neck into the presence of the King; and all the elephants that were in those parts were gathered together into the King's elephant-stable. and there was collected to the army of Islām much treasure because of that expedition. Then Sulṭān Ghiyaṣuddīn Tughlaq Shāh made Sulṭān Nāṣiruddīn, Governor of Lakhnautī, and entrusted to him the kingly power, because he had hastened to do obeisance, and sent him to his government. But of Satgānw and Sunārgānw he took possession. And Bahādur Shāh he sent with a halter round his neck to Dehlī, and Sulṭān Tughlaq Shāh returned in triumph and with victory towards Tughlaqābād. In Delhī also the news of the victory in Bengal was read in all the pulpits, and canopies were erected, and the drums were beaten and there was much rejoicing."

On comparing these two accounts with the numismatic evidence at our disposal various facts emerge. In the first place it is clear that Shamsuddīn Fīrūz Shāh could not have died before 722, so that the doubts cast by Blochmann on Thomas' reading, 722, on a coin of Shamsuddīn, and his limitation of the latter's reign to 717 or 718,[1] cannot be upheld. Secondly, the existence of the series of Ghiyāṣuddīn Bahādur's coins from 720–723, and the absence of coins of Shihābuddīn after 718 tend to show that the eviction of Shihābuddīn from Lakhnautī by his brother took place in 719 or 720 (i.e. before their father's death) and that it was probably only the usual general massacre of brothers that was attempted by Ghiyāṣuddīn on the death of Shamsuddīn in 722 or 723 that led to the appeal of Shihābuddīn and a previously unrecorded brother Nāṣiruddīn to the Sulṭān of Dehlī in the latter year. Lastly, while Tatar Khān, the Sulṭān's adopted son, was apparently given a general commission to bring Bengal completely under the suzerainty of Dehlī, Nāṣiruddīn was appointed Sulṭān of Lakhnautī in succession to Ghiyāṣuddīn, the claims of Shihābuddīn, if he or any other son of Shamsuddīn were still alive, being passed over, as "by his humility and submission Nāṣiruddīn had established a preferential claim to the office."[2]

The installation of Nāṣiruddīn as Sulṭān of Lakhnautī is confirmed by the issue of the British Museum coin noted by Rodgers (*J.A.S.B.*, 1894, p. 67. and No. 19, Pl. V), modelled on those of Ghiyāṣuddīn Bahādur and struck in the joint names of Ghiyāṣuddīn Tughlaq and Nāṣiruddīn. The obverse runs:—

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[1] *J.A.S.B.*, 1874, p. 289.

[2] So Blochmann (*idem*) paraphrases Baranī's words *kih dar itā'at o bandagī sabqat namūdah būd.*

السلطان الاعظم
غياث الدنيا والدين
ابو المظفر تغلق شاه
السلطان

The first two lines are identical with the first two lines of the coins of Bahādur, and the whole fabric of the coin shows that it was almost certainly issued from Lakhnautī and that it was the work of Bahādur's own mintmaster. The reverse, which supplies us with the actual name of Nāṣiruddīn, viz.: Ibrāhīm, runs:—

السلطان المعظم
ناصر الدنيا والدين
ابو المظفر ابراهيم شاه
السلطان بن سلطان

The change of Bahadur's title *Al-Sulṭān bin Sulṭān* on the obverse to the simpler *Al-Sulṭān* of Tug͟hlaq is noteworthy, and although in the first line of the reverse Ibrāhīm acknowledges by adopting the humbler *Al-Mu'aẓam* (instead of *Al-'Aẓam*) that he is subordinate to Tug͟hlaq, the concession in the last line of Ibrāhīm's higher claim to regal paternity shows that Tug͟hlaq fully recognised that he was dealing with no ordinary upstart, but a King of more aristocratic descent than himself. As the coin practically consists of two obverses, there is no margin from which the date might have been obtained, but from the fact that G͟hiyāṣuddīn Tug͟hlaq's death took place in 725 A. H. the coin must have been struck either in this, or the previous year.[1]

On the very day that he returned from Bengal to Tug͟hlaqābād (Dehlī) G͟hiyāṣuddīn Tug͟hlaq died by the fall of a temporary pavilion in which he had partaken of a feast of welcome, and was succeeded by his son Muḥammad ibn Tug͟hlaq Almost the first act of Muḥammad was to liberate Bahādur and send him back to Bengal to share that kingdom jointly with (apparently) his brother Nāṣiruddīn Ibrāhīm. Our only contemporary authority for the re-instatement of Bahādur (except the evidence of coins that will be subsequently mentioned) is Ibn Baṭūṭah, who gives the following particulars of Bahādur and his subsequent fate.[2]

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[1] A reproduction of this coin may be seen in No. 3, Pl. XVI, published with Numismatic Supplement No. XVI of *J.A.S.B.* for 1911. Mr J. Allan states that it came from the Sonpat hoard, Punjab.

[2] *Op. cit* (Arabic text), pp. 316 and 317.

Account of the beginning of Muḥammad ibn Tughlaq's reign and his clemency to Bahādur Būrah.

"When the Sulṭān was invested with power on the death of his father, and the people had taken the oath of allegiance to him, he summoned Ghiyāṣuddīn Bahādur Būrah, whom Sulṭān Tughlaq had captured. He pardoned him, and removed his fetters, and gave him many gifts of money, horses, and elephants, and sent him back to his kingdom (Bengal). He sent with him his brother's son, Ibrāhīm Khān,[1] and arranged with Bahādur that they should share that kingdom equally, and that their name should appear together on the coinage, and that the *Khutba* should be in their common name, and also that Ghiyāṣuddīn should send his son, Muḥammad, known as Barbat, as a hostage with the Sulṭān (of India).

"Then Ghiyāṣuddīn returned to his kingdom, and fulfilled what he had agreed to do, save that he did not send his son, as he pretended that the latter was unwilling (to go). He was also impolite in his correspondence. On this, the Sulṭān sent his armies to (the assistance of) his brother's son Ibrāhīm Khān, under the command of Duljī At-Tatarī. They fought against Ghiyāṣuddīn and slew him, and stripped off his skin. The skin was then filled with straw, and sent round the Provinces."

Ibn Baṭūṭah's account is sufficiently clear except that it makes out Ibrāhīm to be a brother's son of Muḥammad ibn Tughlaq instead of Ghiyāṣuddīn's brother: but this may possibly be due to the mistaken insertion by a copyist of ابن in the manuscript before اخيه. It also implies that Nāṣiruddīn Ibrāhīm was alive at the time of his brother's second capture, which, as will be seen later, is incorrect. Ferishtah, who completed his History of the Muhammadan Dynasties of India in 1609 A.D., adds two additional pieces of useful information, quoted probably from some other early historian of Bengal whose work has not reached us. The first is that, simultaneously with Bahādur's reinstatement by Muḥammad ibn Tughlaq, Tatar Khān (whom we have already met as the chief agent in Ghiyāṣuddīn Tughlaq's conquest of Bengal) was appointed to the Government of Bengal with the title of Bahram Khān and received 100 elephants, a crore of gold *tankas* and 2000 horses.[2]

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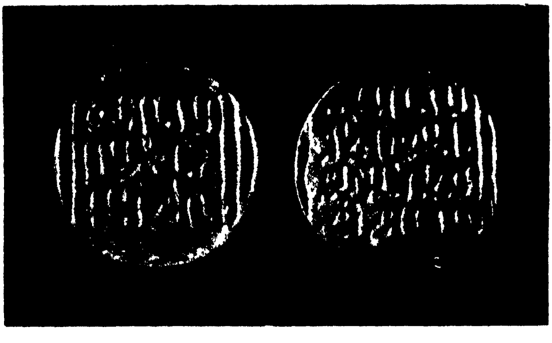
[1] Blochmann's suggestion (*J.A.S.B.*, 1874, p. 290) that here and later, "his adopted brother Bahrām Khān" should be read is unnecessary in this place at all events, though possibly in the case of the second reference there has been confusion between Ibrāhīm and Bahrām.

[2] Bahrām Khān's headquarters was probably Sunārgānw where (according to Ferishtah) he had acted as Governor, i.e. during the period of Bahādur's confinement at Dehlī. Thus, Baranī speaks later as if Fakhruddīn, the next independent King of Bengal, revolted against Muḥammad ibn Tughlaq at Sunārgānw, after Bahrām Khān's death, and

His position seems to have been that of Imperial High Commissioner in Bengal to keep a watchful eye on behalf of the Dehlī Sulṭān over the proceedings of the now feudatory Balbanī Kings. The second is that Nāṣiruddīn died apparently in the year following his confirmation in the sovereignty of Lakhnautī and that in his place Malik Bedār (or Pindār) Khān Khiljī was made Governor of Lakhnautī and received the title of Qadar Khān.

We also gather from another late historian, Badāonī (c.1595 A.D.), that at some unspecified but early date in Muḥammad ibn Tughlaq's reign Satgānw was placed under a separate Governor called Malik 'Izzuddīn Yaḥyā 'Azamu l-Mulk. This agrees with Baranī's statement that Satgānw (with Sunārgānw) had been kept directly under the power of Ghiyāṣuddīn Tughlaq: but as Badāonī mentions 'Izzuddīn after Pindār Khiljī, the formation of Satgānw into a separate Governorship might have been effected after the death of Nāṣiruddīn.

No coins in the joint names of Ghiyāṣuddīn Bahādur and Nāṣiruddīn Ibrāhīm are known but Firishtah's date of 726 for the latter's death is confirmed by coins struck in the name of Muḥammad himself at Shahr Lakhnautī in 727 A.H.[1] The coin cabinet of the British Museum contains, however, a hitherto unrecorded and possibly unique coin issued in the joint names of Muḥammad and Nāṣiruddīn From the annexed cut it will be seen that the inscriptions run as follows:—



Coll. Bleazby No 2085. AR. Wt. 166·9 grs. : S. 1·1 in.

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made that town the headquarters for his successful attack on Muḥammad's other Governor, Qadar Khān, at Lakhnautī.

[1] *Vide* Pl. X, fig. 10. These coins (as well as those of Lakhnautī dated 733 A.H.—*Vide* Table on next page but one) differ from those of Satgānw and Sunārgānw (Nos. 2 (*a*) and 3) in reading الفضة for السكة in the margin.

Obverse : السلطان الا

عظم محمد شاه السلـا

طان بن سلطـان

Reverse. As in the coin of Nāṣiruddīn, previously described, except that at the end of the first line المعظم occurs instead of the incorrect الا معظم.

Though the name of the suzerain is only given as Muḥammad, there can be no doubt that the monarch in question is Muḥammad ibn Tug͟hlaq The date of the coin is probably 726.

Only five coins (two gold and three silver) struck by Bahādur after his reinstatement in Eastern Bengal have been recorded [1] and these all bear the date 728 and mint name Haẓrat Sunārgānw. The inscription on these coins, as given by Thomas in the case of the silver coin. runs as follows :—

Obverse : السلطان المعظم غياث الدنيا والدين ابو مظفر

بهادر شاه السلطان ابن السلطان

Reverse (Area) : ضرب بامر الواثق بالله محمد بن تغلق شاه

(Margin) : هذا السكه بحضرت سنارگانو سنه ثمان

و عشرين و سبعماية

The occurrence on the reverse of the sentence " struck by order of Him who trusts in God, Muḥammad bin Tug͟hlaq S͟hāh " shows, in comparison with the legend on the coin of Nāṣiruddīn Ibrāhīm and G͟hiyāṣuddīn Tug͟hlaq previously referred to, the increased subordination that had been exacted from Bahādur by the Dehlī Sulṭān

For the approximate date of Bahādur's death we must turn to a consideration of the coins struck by Muḥammad ibn Tug͟hlaq in Bengal as well as a rather complicated argument that can be gathered from the pages of Ibn Baṭūṭah.

The dates and mints of all the Bengal coins of Muḥammad that I have been able to trace are summarised in the following table :—

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[1] Thomas, *Initial Coinage of Bengal*, I. p. 55; and *idem.*, II p. 36 : *J A.S.B.*, 1921, Num. Suppl., p. 153. There is also a sixth (silver) specimen of this coinage in the Indian Museum Cabinet.

Mint.	Type and Metal.	Date.	Reference and Provenance.
1 (*a*) S̲h̲ahr Lakhnautī	*I.M C.*, No. 321 (Dehlī, 725) : Silver	727(1); 728(2); 729 and 730(3); 733(4)	(1) *L.M.C.*, p. 48, No. 1; B.M. (Coll. Bleazby: 2 coins); and H.E.S. (Enāyetpur). (2) B. M. (Coll. Bleazby; 2 coins). (3) Coll. H. R. Nevill (*J.A.S.B.*, Vol. XVII, 1921, p. 133). B. M. (Coll. Bleazby) has also a coin of 729. (4) Thomas, *I.C.B.*, I, p. 56 (Col. Guthrie's 5 coins).
	Do. : Gold ..	734(5)	(5) Coll. H. R. Nevill (*idem*).
1 (*b*) Iqlīm Lakhnautī.	*I.M.C.*, No. 375 (Dehlī, 730): Forced currency.	731(1) : 732(2)	(1) *I.M.C.*, No. 382. (2) Rodgers, *J.A.S.B.*, 1883, p. 59.
2 (*a*) Satgānw	As in 1(*a*): Silver ..	729, 730, and 733(1); 734(2)	(1) *I.M.C.*, Nos. 324 325 and 327. (2) H.E.S. (Enāyetpur).
	Kalimah-type (without names of Companions): Gold.	734 and 735(3)	(3) *L.M.C.*, p. 47, Nos. 2 and 1.
2 (*b*) Arṣah Satgānw.	As in 1(*b*): Forced currency.	730(1); 731(2)	(1) *I.M.C.*, No. 383. (2) Rodgers, *loc. cit.*, p. 60.
3 S̲h̲ahr Sunārgānw.	As in 1(*a*): Silver ..	733 and 734(1)	(1) H.E.S. (Enāyetpur).

From this table it would appear that, apart from the Lakhnautī coins that began to be struck after the decease of Nāṣiruddīn, there was no issue of Bengal coins in the sole name of Muḥammad ibn Tug̲h̲laq until 729. The sudden activity of a second mint in this year may, very reasonably, be connected with G̲h̲iyāṣuddīn having been defeated and slain at about this date.

Ibn Baṭūṭah unfortunately supplies no facts from which any really definite confirmation of this date can be obtained, but the following may be noted in support of it. On his arrival in India in 734,[1] Ibn Baṭūṭah saw at Multān suspended over the door of the palace of Kis̲h̲lu K̲h̲ān *alias* Malik

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[1] *Op. cit.*, III, p. 93.

Bahrām 'Abiah, late Governor of Sind and Multān, the head of the deceased Governor.[1] Kis̲h̲lu K̲h̲ān's death had occurred as the result of Muḥammad ibn Tug̲h̲laq's anger when he heard that this Governor had buried the skins of Bahādur and of Bahāuddīn Gus̲h̲tasp on their reaching his hands, when the two skins stuffed with straw, were being sent round the Provinces as a warning to other would-be rebels. Bahāuddīn was a nephew (sister's son) to G̲h̲iyāṣuddīn Tug̲h̲laq and after the accession of Muḥammad to the throne of Dehlī, he refused to take the oath of allegiance and fled for refuge to the Rai of Kanbilah in the Deccan. He was finally caught, and on his being brought into Muḥammad's presence, the Sulṭān ordered him to be skinned alive and his flesh to be made into a curry which was sent to his wife and children to eat.[2] From the fact that his flight to Southern India occurred in consequence of his not being willing to take the oath of allegiance, his death must have taken place fairly soon after Muḥammad became Sulṭān of Dehlī: but in view of the existence of coins of Bahādur dated 728, I cannot agree with Defrémery and Sanguinetti's acceptance (on the authority of K̲h̲ondemir, the Persian author of a Universal History called *Habību-s-Siyār*, who died in 1534 A.D) of the end of 727 as the date of Kis̲h̲lu K̲h̲ān's death.[3] Badāonī, on the other hand, gives[4] the date of Gus̲h̲tasp's breaking out into rebellion as the end of 727, and Ranking notes that in this he is supported by the Bombay text of Feris̲h̲tah (though Briggs in his translation makes Feris̲h̲tah postpone it to the impossible date of 739). If therefore Badāonī and Feris̲h̲tah are correct, this would point to some time in 728 (or even 729, if one considers Ibn Baṭūṭah's account of Gus̲h̲tasp's subsequent adventures in Southern India).[5] In view of the fact already mentioned that both Gus̲h̲tasp's skin and that of Bahādur arrived together at Multān, we may finally conclude that the death of G̲h̲iyāṣuddīn Bahādur took place either towards the close of 728 or early in 729

Thus ended, in abject ignominy, the line of Balbanī kings of Bengal. The apparent cessation of Imperial coinage in Bengal in, or shortly after, 735 points to a sudden outbreak of internal trouble; and though, as we shall see in the next section of this paper, historians record that Muḥammad's Governors continued in power for some years longer, they were ultimately replaced, after a period of anarchy, by independent Kings, and

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[1] *Idem*, p 324.

[2] *Idem*, III, p. 321.

[3] *Op cit.*, III, Preface, p. XX.

[4] Ranking's translation, I, p. 304.

[5] Badāonī goes on to say "After that, Malik Bahrām Iba, the adopted brother of Sultān Tug̲h̲laq, raised a rebellion in Multān," which Muhammad ibn Tug̲h̲laq had to suppress in person. All this agrees perfectly with Ibn Batūtah's account of the rising of Kis̲h̲lu K̲h̲ān.

Bengal again ceased to acknowledge the suzerainty of the Sultāns of Dehlī.

Received February 25th 1921.

APPENDIX A.

GENEALOGICAL TABLE OF THE KINGS OF BENGAL, DEALT WITH IN PART I.

Balban, Sultān of Dehlī.

Nāṣiruddīn Maḥmūd, of Bengal.
c. 682–690 A.H.

Ruknuddīn Kaikāūs 690–701.	Shamsuddīn Fīrūz 701–722.

Jalāluddīn Maḥmūd 709 (or 707).	Ghiyāṣuddīn Bahādur (struck coins at intervals from 710 to 728, those in 728 in joint name of the suzerain, Muḥammad ibn Tughlaq, Sultān of Dehlī).	Shihābuddīn Bughrah 717 and 718.	[Katlu Khān and other brothers, slain by Ghiyāsuddīn]	Nāṣiruddīn Ibrāhīm 724–726 (under suzerainty of Dehlī Sultāns)

APPENDIX B.

BENGAL MINTS OF KINGS DEALT WITH IN PART I.

Kings.	Mints.	Date on Coins. (Silver unless otherwise stated.)
[Nāṣiruddīn Maḥmūd ..	No coinage	known.]
Ruknuddīn Kaikāūs ..	Lakhnautī ..	690.
	("from the *Kharāj* of Bauga")	
	Lakhnautī ..	693, 697, 698 and 699 (?) (Thomas 691 and 693–5
Shamsuddīn Fīrūz ..	Lakhnautī ..	701. 702. 703, 704, 706, [70]7, [70]9, 710, 71[1?], 712, 713, 714, 715 and 720.
		(Thomas: 702, 715, 72 and 722).
	[Lakhnautī ?] ..	*AV* (*I.M.C.*, No. 9: undated).

Kings.	Mints.	Date on Coins. (Silver unless otherwise stated.)
Shamsuddīn Firūz (*Contd*).	Sunārgānw	705 and 710.
	Banga	[70]5.
Jalāluddīn Maḥmūd	Lakhnautī ("from the *Kharāj* of Banga").	709 (or 707).
Ghiyāṣuddīn Bahādur	Lakhnautī	710, 714, 720, 721, 722 and 723 (Thomas also gives coins of 711 and 712).
	Sunārgānw	717.
	Qaṣbah Ghiyāṣpur.	722.
Ditto (under suzerainty of Muhammad ibn Tughlaq of Dehli).	Sunārgānw	728 (AR and AV).
Shihābuddīn Bughrah	Lakhnautī	717 and 718.
Nāṣiruddīn Ibrāhīm—		
1. Under suzerainty of Ghiyāṣuddīn Tughlaq of Dehlī.	[Probably Lakhnautī].	Undated [724 or 725].
2. Under suzerainty of Muḥammad ibn Tughlaq.		Undated [725 or 726].
Muḥammad ibn Tughlaq, Sulṭān of Dehlī.	Shahr Lakhnautī	727, 728, 729, 730 and 733.
		734 (AV).
	Iqlīm Lakhnautī	731 and 732.
	Satgānw	729, 730, 733 and 734.
		734 and 735 (AV Kalimah type).
	Arṣah Satgānw	730 and 731.
	Shahr Sunārgānw	733 and 734.

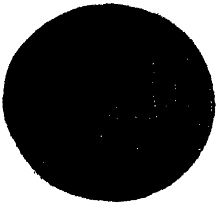
APPENDIX C.

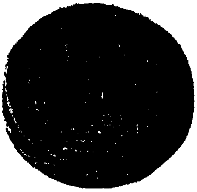
PLATE X.

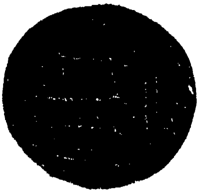
Muslim Coins of Bengal, 690–727 *A.H.*

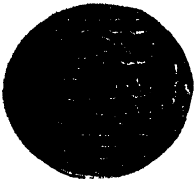
(Reverse in each case, except No. 10.)

1. RUKNU-D-DĪN KAIKĀŪS	I.M.C., No. 8; Wt. 168 grs. S. 1·2 inch. (690 A.H. instead of 693: Mint, "LAKHNAUTĪ from the revenue of BANGA").
In double square inscribed in a circle:— (1) *Al Imām.*	*Margin.—Ẓarb haẓa alfiẓẓa* (*bihaẓrat*) *Lakhnautī min kharāj Banga sanah tisa'inwasitt,*









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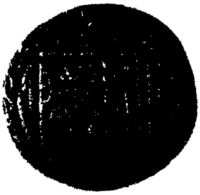

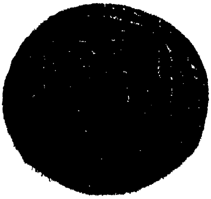

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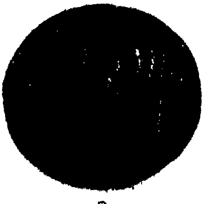

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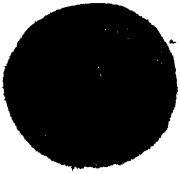

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Photogravure. Survey of India Offices Calcutta 19[illegible]3

EARLY MUSLIM COINS OF BENGAL

(2) *Al Musta'sim Amīr* (3) *Al Mūminīn.* ′ over first *mīm* of *Imām.*	*miat.*
2. SHAMSU-D-DIN-FĪRŪZ ..	S.C No. ⅛; Wt. 168·5; S. 1 1: Provenance Purinda, Dacca District (701 A.H : Mint, traces of LAKHNAUTĪ).
In double square inscribed in a circle. Inscription as in No. 1, but period mark ~ over first *mīm* of *Imām.*	*Margin* —Traces of margin, as in No 1, to Lakhnautī, followed by: *Sanah ahadi wa-suba' miat.*
3 SHAMSU-D-DIN FIRŪZ ..	S.C. No. 1/12; Wt. 168·9; S 1·06: Provenance, Purinda ([70] 5 A.H.: Mint, SUNĀRGANW).
Inscription as in No. 2 ..	*Margin.* .*(ha)ẓrat Sunārgānw sanah khams*.......... (no space for any decimal, as marginal inscriptions in Fīrūz's coins begin at the top).
4. SHAMSU-D-DĪN FĪRŪZ ..	S C. No. ' ; Wt. 168·5; S. 1·05: Provenance, Rupaibāṛī, Nowgong. Assam ([70]5 A.H : Mint, BANGA).
Insciiption as in No. 2 ..	*Margin* ... *(ha)ẓrat Banga sanah khams*... ....(no space for any decimal).
5. JALĀLU-D-DIN MAHMŪD	S.C. No. 1/12; Wt. 168·5; S 1·1; Provenance, Purinda (707-or 9-A.H. : Mint," LAKHNAUTI from the revenue of BANGA ").
Inscription as in No 2, but with i of *Amīr* missing and period mark ⸗ over first *mīm* of *Imām.*	*Margin* —*Ẓarb haẓa al-fiẓẓah bihaẓrat Lakhnautī min kharāj Banga sanah saba'* (or *tisa'*) *wasiba' miat* (there is a superfluous pellet—? isolated و—after the unit).
6. SHIHĀBU-D-DIN BUGHRAH	H.E.S.; Wt. 164·5; S. 1·04; Provenance, Murshidabad ([7]17 A.H.: Mint, LAKHNAUTĪ).
Inscription as in No. 2, but with period mark ~ over *mīm* of *Imām* (cf star in I M C. .No. 13).	*Margin*...*Lakhnautī sanah saba' 'ashara*...
7. GHIYĀSU-D-DIN BAHĀDUR	S.C. No. 8/10; Wt. 167·9; S. 1·06; Provenance, Enāyet-

	pur (722 A.H —not 721 as in S.C. Supplement—Mint, G̲HIYĀṢPŪR.
Inscription as in No. 2, but G̲hiyāṣuddīn's usual mark ∴ over *mīm* of *Imām*.	*Margin.*—(starting at middle right) *Ẓarb haẓa al-sikkah qaṣbah G̲hiyāspūr* [*fi shahr Safar* (?)] *sanah it̲hnī 'ishrīn wasaba' miat.*
8. G̲HIYĀṢU D-DĪN-BAHĀDUR	S.C. No. $\frac{2}{4}$; Wt. 169·7; S. 1·1; Provenance, Purinda (717 A.H.: Mint, SUNĀRGĀNW).
Inscription as in No. 2, but with period mark ⁓ over *mīm* of *Imām* (cf. mark in previous Sunārgānw coin. This is the only known coin of G̲hiyāṣuddīn with this mark instead of the usual ∴).	*Margin.*—(starting at middle right) *Ẓarb haẓa* (traces of *al-fiẓẓah bihaẓrat*) *Sunārgānw sanah saba' 'ashara wa-saba' miat.*
9. G̲HIYĀṢU-D-DĪN BAHĀDUR	H.E.S.; Wt. 167·1; S. 1.08; Provenance, Enāyetpur.
Inscription as in No. 7 ..	*Margin.*—clear, but evidently the work of an engraver completely ignorant of Arabic who has endeavoured unsuccessfully to copy the usual margin: cf. *sanah* twice repeated; and *bihaẓrat ẓarb* (sic!)
10. MUḤAMMAD IBN TUG̲HLAQ	H.E.S.; Wt. 169·7; S. ·96; Provenance, Enāyetpur (727 A.H.: Mint, S̲HAHR LAKHNAUTĪ).
(*Obverse.*)	
Inscription: In a circle the *Kalimah*.	*Margin.*—*Ẓarb haẓa al-sikkah S̲hahr Lakhnautī sanah saba' 'ishrīn wa-saba' miat.*

30. Primogeniture in Ancient India.

By Nirmal Chandra Chatterjee, M.A.

The history of the law of primogeniture in ancient India is very interesting and shows the different stages of the steady decline of the primeval custom of the *patria potestas* in early societies.

In the Vedic literature we find that primogeniture was generally the law of succession (e.g., Aitareya-Brāhmaṇa, iv, 25 & vii, 17–18). With the gradual emancipation of the sons or the brothers from the authority of the family patriarch primogeniture steadily gave way to equal distribution.[1] Gautama, the author of the earliest Dharma-Sūtra, is in favour of primogeniture: Ūrdhvaṁ pituḥ putrā rikthaṁ bhajeran | Nivritte rajasi mātur = jīvati v = echchhati || Sarvaṁ vā pūrvajasy = etarān bibhṛiyāt = pitṛivat || Vibhāge tu dharma-vriddhiḥ Viṁśati-bhāgo jyeshṭhasya mithunam = ubhayato – dad = yukto ratho go-vṛishaḥ || Thus Gautama is in favour of the whole estate going to the eldest son, and even in partition he allows him an additional share of a twentieth part of the estate (28, 1–5; S.B.E., II, page 299). Baudhāyana, who appears after Gautama, enjoins three different methods of distribution of the parental estate: (1) gift of an equal share by the father to each son—on the authority of a Vedic passage (Taittirīya-Saṁhitā, iii, 1, 9, 4) which clearly points to equal division; (2) allowing the eldest son "the most excellent chattel" on the authority of another Śruti text (Taitt. Saṁ. ii, 5, 2, 7); and (3) a preferential share of 1/10th of the property to the eldest son. Baudhāyana sounds a distinctly liberal note and does not strenuously advocate primogeniture like his predecessor Gautama. (II, 2, 3, 4–9; S.B.E. XIV, pages 224–5). Āpastamba, the next Hindu Jurisconsult, marks a more advanced stage. According to him the father should make an equal division of his property "after having gladdened the eldest son by some (choice portion of his) wealth," i.e., after making him a present which should have some value but which should not be so valuable as to materially affect the equality of shares [2](II, 6, 13, 13 & II, 6, 14, 1; S.B.E. II, p. 132). Later on he ably controverts the views of the advocates of primogeniture and points out that it is antagonistic to the clear precepts of the Veda. He quotes and interprets the Vedic passage (Taitt. Saṁ. iii, 1, 9, 4) in support of his view, and argues that the other text (Taitt. Saṁ. ii, 5, 2, 7) is merely a statement of fact and has not the force of an injunction (*vidhiḥ*). He emphatically asserts that the preferential treatment of the eldest son "is forbidden by the Śāstras." (II. 6, 14, 10–13; S.B.E. II, p. 134–5). Vaśishṭha gives the eldest son a double share and a tithe of the kine and horses (XVII, 42–3: S.B.E, XIV, page 88). Kauṭilya also provides for a preferential treatment of the eldest son:—

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[1] "As for the method of division, it is clear from the Taittirīya Saṁhitā (ii., 5., 2., 7) that the eldest son was usually preferred." (Vedic Index, Vol. I. p. 352.)

[2] *Vide* Bühler's Introduction, S.B.E., Vol. II, page xx.

Eka-strī putrāṇāṁ jyesṭh-āṁśaḥ ॥ Brahmaṇānām = ajāḥ; Kshatṛiyāṇām = aśvāḥ; Vaiśyānāṁ gāvaḥ, Śūdrānām = avayaḥ ॥ Chatushpad ābhāve ratna-varjānāṁ daśānāṁ bhāgaṁ dravyāṇāṁ = ekaṁ Jyesṭho haret। Pituḥ parivāpādyānam = ābharaṇaṁ cha jyeshṭhaḥ। Śesha-dravyāṇām = etad = dravyasya vā samo vibhāgaḥ ॥ (Artha-śāstra, Bk. III, Ch. VI).

"Goats shall be the special shares of the eldest of sons, among Brāhmans; horses among Kshatriyas; cows among Vaiśyas; and sheep among Śūdras ...... In the absence of quadrupeds the eldest shall take an additional share of 1/10th of the whole property .... The father being dead, his carriage and jewellery shall be the special share of the eldest ...... The rest of the property, or the above things too, may be equally divided among themselves." (A S., p 206) Manu allows 1/20th to the eldest and the best of all chattels (IX, 112; S.B E., XXV, page 347); but Manu like Kauṭilya is no blind supporter of primogeniture as he strictly enjoins separation and partition if the eldest brother "behaves in a manner unworthy of an eldest brother" (IX, 110; S.B E., XXV, pages 346-7). Vishṇu gives 1/20th part of the inheritance to the eldest as his additional share (XVIII, 37: S B.E., VII, page 73). But Yājñavalkya takes a bold stand against the claim of the eldest son to a special share:—

"Vibhajeran sutāḥ pitror = ūrdhvam = ṛiktham = ṛiṇaṁ samaṁ"

"Let the sons divide the wealth of their deceased father equally among themselves." (II, 117) (Stenzler's edition, page 58). Nārada virtually abrogates the right of primogeniture as he declares that even the youngest son may be the head of the family and may undertake the management of the family property, if specially qualified for the task (XIII, 5; S B.E., XXXIII, page 190). Bṛihaspati is clearly in favour of equal division:—

"Partition among coparceners is declared to be of two kinds; one is with attention to priority of birth, the other consists of the allotment of equal shares.

"All sons of the twice-born, begotten on women equal in caste (to their husbands), shall take equal shares, after giving a preferential share to the eldest.

"He who is the first by birth, sacred knowledge, or good qualities, shall take a couple of shares out of the partible wealth, and the rest shall take equal shares.

"When they divide their father's heritage all the sons shall share alike." (XXV, 7-10, S.B.E., XXXIII, page 371.) Kātyāyana is also against special treatment of the eldest son. This triumph of equality over primogeniture marked the complete emancipation of the junior coparcener from the control of the head of the family exercised by the father or the eldest brother.

In studying the evolution of primitive polities we notice two important characteristics, namely, agnation and *patria potestas*. With the progress of society, as we follow the transition from the tribal to the territorial state, both these characteristics were slowly impaired. In ancient India as in ancient Rome and in other ancient states the family patriarch was gradually shorn of most of his prerogatives and the stringency of the *patria potestas* was considerably mitigated. In the same way non-agnates gradually received admittance into the family-fold. All this clearly demonstrates the gradual disintegration of the patriarchal family, which is also proved by the history of the law of primogeniture as has been noticed above. Thus the members of the family other than the patriarch gained a recognised status in the ancient family and, to put it in the more intelligible language of modern civilised society, the triumph of aggressive individualism over primitive communalism was definitely proclaimed.

31. Lâḷa—A Note.[1]

By H. C. Ray.

It is generally believed in Bengal that prince Vijaya the traditional conqueror of the beautiful island of Ceylon is a Bengali. The origin of this belief as far as is known to me is contained in the Buddhist Chronicles of Ceylon which describe the story of the early conquest and settlement of the civilized races in the Laṅkādvīpa. The belief has become so very general that it has entered in the popular songs and ballads of this province. We give below a brief summary of the story from the Mahāvaṁsa :—[2]

> In the country of the Vaṅgas in the Vaṅga capital there lived once a king of the Vaṅgas. The daughter of the king of the Kaliṅgas was the king's consort. The issue of this marriage was a 'very fair' and 'amorous' daughter who while travelling with a caravan between Vaṅga and Magadha was carried away by a lion in the forests of the Lāḷa country The lion begot on her a son, Sîhavāhu and a daughter Sîhasîvali. After slaying his father Sîhavāhu became king of Vaṅga But he abdicated in favour of his mother's husband and taking his sister as his wife built the city of Sîhapura 'in the forest stretching a hundred yojanas' and reigned over the kingdom of Lāḷa. His eldest son Vijaya banished for his lawlessness sailed with a band of 700 followers from Sîhapura and at first 'landed at the haven called Suppāraka' but continuing his voyage he came to Laṅkā very shortly before the death of the Tathāgata.

It will be noticed that in the story prince Vijaya is represented to be a son of Sîhavāhu the King of Lāḷa. But what is Lāḷa? Scholars are far from unanimous in their identification of this country.[3] Childers. Goldscmidt and Kuhn considered it as a division or a border state of Magadha. Dr. E Müller took it to be a 'part of the later kingdom of Kālinga.' Bournouf and Manmohan Chakravarty identified Lāḷa with Rāḍha. All these scholars place Lāḷa on the eastern coast but Rhys Davids evidently following Lassen looks for Lāḷa on the west coast of India. They identify it with the province of Lāṭa or Lāṭika, the Λαριχη of the classical authors. (Mod. Gujarāt.) Writing in the *Cambridge History of India* on the *History of Ceylon* Dr. L. D. Barnett has recently endorsed this view and has discovered the following nucleus of fact in the story. He observes[1]:—

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[1] This note on Lāḷa was written in October last. Since then Dr. Raychowdhury in reviewing *The Cambridge History of India*, Vol. I in the *Calcutta Review* for December, 1922, has come to my conclusion. I am however publishing this note because it sets forth in full the facts which lead to that conclusion and also because it contains in brief the references to the previous discussion of this question.

[2] P.T.S. Trans. by Geiger and Bode., pp. 51–54.

[3] *Ind Ant.*, Vol. XI, p. 198, note 2 ; Vol. XII, pp 54–55 and p. 65. *Ind. Alterth.*, Vol. II, p. 105 ; Bournouf, *Recherches sur la Géographie Ancienne de Ceylon*, p. 61 ; *J.B.A.S. New Series*, Vol. IV, p. 286. Mr R. P. Chanda also takes Lāḷa in the sense of Rādha ; see *Sir Asutosh Mookerjee Silver Jubilee Volumes*, Vol. III, *Orientalia*, part I, p. 113.

> 'There were apparently two streams of immigration celebrated in the earliest legends The first which probably was mainly Dravidian came from Orissa and perhaps southern Bengal The second mainly Aryan started from Sîhapura in Lāṭa (possibly the modern Sihor, in Kathiāwar) and Sopāra. The latter band belonged to the Simhalas (Sihalas) or Lion tribe, and it was probably they who imposed their Aryan tongue on Ceylon. At any rate they gave to their new home the name Siṁhaladvîpa (in Pali Sīhaladîpa), whence derived its later titles, the Arabic Sarandip, the Portugese Ceylon, and our Ceylon.'

Here I have nothing to say as regards the theory of the learned Doctor. It is possible that Ceylon was colonized by two distinct streams of immigration, one from the Bengal coast and another from the Kathiwad peninsula. It is even possible that one was mainly Dravidian while the other was Aryan. The fact that Vijaya after starting from the Lāḷa country at first landed at Śūrpāraka seems to indicate that the early colonization and settlement of Ceylon probably had some connection with the western coast But even granting this we cannot accept the identification of Lāḷa with Lāta. The geographical data contained in the Mahāvaṁsa do not agree with this assumption. The story tells us—

> 'Alone she went from the house (in the Vaṅga capital) desiring the joy of independent life; unrecognised she joined a caravan travelling to the Magadha country. In the Lāḷa country a lion attacked the caravan in the forest'[2]

It will be observed that the country though distinct from Magadha and Vaṅga, was situated between the two Janapadas. Its position was thus between S.E. Bengal and the Patna and Gaya Districts. Apparently Lāḷa must be identified with Rāḍha which was the name of that part of Old Bengal of which the Ganges and its Bhāgîrathî branch formed the eastern boundaries.[1] The contiguity of Lāḷa and Vaṅga is further supported from the fact that when Sîhavāhu fled with his mother and sister from the lion's den in Lāḷa, he very soon came to *a border village* where, 'even at that time, was a son of the princess's uncle, a commander in the army of the Vaṅga king, to whom was given the rule over the *border country*.'[2] It is clear that the officer of the Vaṅga king ruled over the *border country* between Lāḷa and Vaṅga. Moreover the blood relationship of the Lāḷa kings with the Kaliṅga and Vaṅga royal families and the fact that Lāḷa country was then full of forests stretching over hundreds of yojanas, curiously reminding us of the travels of Mahāvîra 'in the pathless countries of the Lādhas,' keep us in no possible doubt that Lāḷa is Rādha.

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[1] Chap. XXV, pp 605-07.

[2] *Mahāvaṁsa*, trans. by Geiger and Bode, p. 51

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[1] *J.A.S.B. New Series*, Vol. IV, p. 287.
[2] *Mahāvaṁsa*, trans. by Geiger and Bode, p. 52.

32. A Note on the Newly *Discovered Bogra Stone-* Inscription.

By HARIDAS MITRA, M.A., *Sometime Government Research Scholar.*

This fragmentary inscription in black clay chlorite was discovered by Babu Pūrṇa Chandra Bhaṭṭāchārya, Dt. Engineer, Bogra, while excavating an old tank at Mahāsthāna, Dt. Bogra. The Varendra Research Society was requested to decipher the record and to report upon the same. A rubbing of the inscription was received through Babu Prabhās Chandra Sēn, B.L., of Bogra and made over to me for decipherment by the Director, Varendra Research Society. The stone slab bearing the inscription has also been brought to the Society with the kind permission of the Government of Bengal. My readings of the inscription with full notes and critical interpretation were duly submitted to the Society. Babu Prabhās Chandra Sēn has also published a version of the text with an impression and a translation in the Bengalee monthly *Bhāratavarṣa* for Śrāvaṇa, 1326 Sāl My version of the text with critical notes, full translation and a reduced impression, which has appeared in the Vaṅgīya Sāhitya Pariṣat Patrikā differs materially from the version mentioned above. Several puns and hidden meanings, not detected before, were explained for the first time.

The record is composed in elegant Sanskrit verses, but it is sadly mutilated, consisting of portions only of 16 lines, the first of which is practically illegible. The fragment of stone is 1 foot 8 inches at its greatest length and 9 inches at the greatest breadth and the preserved letters are beautifully inscribed Some of the lost letters and inaccuracies could be supplied or corrected from metrical considerations and also from the sense. Only one complete verse [d], in Anuṣṭubh is preserved and the beginning letters of a single line (L. 10) are intact.

The number of letters of the record, per line. was found by backward and forward calculation (in the form of a chart) of the long and short vowels beginning from the first letter of line 10. The inscription had 64 to 68 letters (Akṣaras) per line.

The epigraph gives the genealogy of a certain Nandin family; but owing to the mutilated state of the record it is impossible to ascertain their exact home. One member of the family attained great prosperity and renown at a place named *Gopagṛiha*. The word has double meaning. If the record had not been ever removed from its original place of location, then Gopagṛiha might be somewhere near Mahāsthāna. The genealogy of the Nandin family cannot be determined with absolute certainty but very probably it was as follows :—

Vibhūṣita Nandin (Names of predecessors lost.)
|
Śrī-Nārāyaṇa Nandin + Sudarśanā.
|
Sunaya + Arundhatī.
|
Kaṇvāla Nandin + Sarasvatī.
(Names of descendants lost)

The epigraphic alphabet of this fragmentary inscription is undoubtedly a little later in age than the Ghōsrāwā inscription of Vīradēva, with which the epigraph has in common the orthographical peculiarity of expressing anusvāra by a 'na,' when followed by a 's' in the middle of a word and the practice of putting the रेफ-s above the ceriphs. The letters 'pa' and 'ma' especially, are more developed in the Bogra than in the Ghosrāwā, the date of which is put between 800–900 A.D., by Mr. R. D. Banerjee (in his latest book, 'Origin of the Bengalee Alphabet,' p. 58)

The epigraph has a striking similarity as regards the script also with the Haragaurī (Bādāl) Pillar inscription and the slightly more advanced Viṣṇupada Temple inscription, both of the time of Nārāyaṇapāla (beginning of the 10th century). Therefore the date of the Bogra stone slab, which is intermediate between the times of Vīradēva and Nārāyaṇapāla, is very probably between the end of the 9th century and the beginning of the 10th century.

It is impossible to decide now whether the record belonged to any body of the Nandin family in which the Poet, Sandhyākara, the author of 'Rāma [-pāla]-carita' was born. Between Sandhyākara's time (who composed his work during the reign of Madanapāla Dēva—beginning of the 12th century A.D.) and the probable date of the epigraph, a distance, in point of time, of about a century and a half intervenes. Therefore, all attempts to connect the record with Sandhyākara's father, Prajāpati Nandin, the Sāndhivigrahika of Rāma-pāla are indefensible. [*Vide* Kāyastha-Patrikā Chaitra, 1326. B S.]

Text.

L. 1. ———— × navichalā (?) × chhala (?) × ————

L. 2.

× kulamārjjavasya ।
tasmād-ajāyata Vibhū[ṣ]ita-nandi – nāmā

L. 10. —marē sa[pa]tnān
sarvvasvam-apy-asakṛid-arthija[nānu]vṛityā (ttyā) ।
yaḥ prēmṇi ch-āyuṣi × —— ————
———— ———— ———— ———— ॥ [l]
———— ———— ———— ————

L. 11. × —tā
pradhvansaṃ gamitē chirāya supathi svargg-āpavargg-ōnmukhē । lōkaṃ pu — × ———— ———— ————
———— ———— ———— ————॥ [m]
———— ————

L. 12. × ścha vālukājāla-śāyinaḥ ।
mīnāyitā digantēṣu śaṅkitā· ya— × ——॥ [n]
———— ———— ———— ————
———— ———— ———— ———— ।
———— ———— ———— ————

L. 13. ×
śrīr-nn-āgamat-kulavadhū[r]-iva vṛitta-bhaṅgaṃ (m) ॥ [o]
Sarasvatīti yasy-ābhūd-anu— × ———— ———— ।
———— ———— ———— ———— ॥ [p]
———— ————

L. 14. × —ā vinayabhūr-yasy-āparā prēyasī ।
yām-ālōkya satīpa × ai × ——— ———— ————
———— ———— ——— ——— ———— ॥ [q]
———— ———— ———— ×

L. 15. -[gi–?] ṇī ।
rājitā rājahans-īva mānasē yasya × ——— ॥ [r]
———— ———— ———— ————
———— ———— ———— ———— ।
———— ———— ———— ————
———— ————

L. 16. × patēḥ paramādarēṇa ॥ [s]
(The rest of the inscription is entirely lost.)

Tentative Interpretation.

Verses (a), (b), (c) might have referred to Vibhūṣita Nandin
V. (c) Good men frequented his (Vibhūṣita's) house.
V. (d) Śrī-Nārāyaṇa Nandin was like a Śiva (Nandivardhana) of his family.
V. (e) probably described his good qualities.
V. (f) Double entendre. Somebody (very probably, Śrī-Nārāyaṇa) is compared to Viṣṇu in his Kṛiṣṇa incarnation. The place of residence of both was at Gōpagṛiha—(1) house of cowherds; (2) name of a place.
V. (g) extolls the virtues of Arundhatī, whom Sunaya had for his wife.
V. (i) describes the birth and good qualities of Kaṇvāla Nandin.

V. (j) Double entendre,—(probably) Kaṇvāla Nandin on account of his fondness for the company of and his patronage of men of letters, is compared to the Rājahaṃsa that feeds upon sweet lotus roots.

V. (k) describes Kaṇvāla's kindness to men under him and his avoidance of bad company and vile words.

V. (l) describes his liberality.

V. (m) probably, described his pious and meritorious deeds.

V. (n) probably, described his valour.

V. (o) In Kaṇvāla's house, Śrī—fickle Fortune—behaved like a chaste wife. She did not leave Kaṇvāla.

V. (p) Sarasvatī seems to be the wife of Kaṇvāla.

V. (q) probably Kaṇvāla had another wife who was the abode of womanly grace and decorum.

V. (r) probably described the husband's great love for his wife.

33. A Contribution to the Bibliography of Tibet.

By Johan van Manen.

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I. GENERAL INTRODUCTION.

The study of a country, its past, its history, customs, languages, religions and so on, is necessarily largely dependent on the study of its literature. The literature, in its turn, can only be studied in due perspective and proportion when it is adequately known. Bibliographical knowledge about a country precedes therefore the study of its literature, or at least ought to precede it if such study is to be at all systematic. In many countries in the West practical and theoretical requirements have led to a high degree of organization in all matters relating to the production, distribution, collection and description of books, both printed and written. In many countries in the East such organization is either primitive and limited or altogether absent. European scholarship has often produced valuable work with regard to bibliographical knowledge concerning the East, but though such work may be valuable and even voluminous in some departments, it is still insignificant in others, and always incomplete in the highest degree with regard to what has ultimately to be accomplished. In connection with Tibetan studies our bibliographical knowledge is still in its infancy. The literary treasures which our present data induce us to expect as existing must be immense. Lists of Tibetan works published hitherto lead us to surmise that we are only at the very beginning of our discoveries, and that all the titles known to-day, and all the books collected in private and public libraries, represent only a small part of a really immense literature of which we can scarcely estimate the bulk, still less the full nature and contents. The two large Tibetan religious cyclopedias, the Kanjur and the Tanjur, are fairly well known, bibliographically at least, and have, especially of late years, been studied in detail, but these two voluminous compendia, we have now found, do not in any remote way constitute the bulk of Tibetan literature. They may indeed be its two chief monuments, but they are rivalled by others; and extra-canonical literature is now found to be much more extensive than even these two well-known collections added together. Any contribution to our knowledge of this literature, at the present stage of Tibetan studies, cannot fail to be of a certain importance, if it were only to furnish starting points for further research. At one time, through the information brought back from Tibet by Sarat Chandra Das, about the existence in that country of old Sanskrit texts which have long since disappeared from sight in India, great hopes were entertained that in this Land of Snows startling discoveries might be made in that direction. The discovery of such texts in Japan, published by Max Müller, may have encouraged the expectation. This led Emil Schlagintweit, some twenty years ago, to attempt to establish official communications with the Dalai Lama, to obtain from him a list of such texts Schlagintweit was assisted in his attempts by Rockhill, Sarat Chandra Das and others, but the whole undertaking came to nothing. Its legacy is a rather amusing and prolific description of the attempt, together with all documentary material connected with it, which Schlagintweit published in Munich[1] in 1904, and which is a very serious report concerning a more or less comic episode in the progress of Tibetan studies. I have, however, followed Schlagintweit's example in a more unambitious and unofficial manner. Having made the acquaintance of and formed friendships with several Tibetans, both permanently residing in British territory, or only temporarily visiting it, I have been on the look out for a suitable agent to furnish me with some information similar to that sought by the German scholar, though not going so far as to expect any concerning

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[1] Bericht uber eine Adresse an den Dalai Lama in Lhasa (1902) zur Erlangung von Bucherverzeichnissen aus den dortigen buddhistischen Klöstern. Von Emil Schlagintweit. Abh. K. Bayer. Akademie der Wiss. I.Kl. XXII Bd. III Abt. Munich 1904.

Sanskrit texts probably still extant in Tibet.[1] I wished to have a report about the current literature of the country to find out whether any such report would go beyond the information already in our possession. I expected that this more limited line of enquiry would in all probability prove more fruitful. I was not deceived in my expectations. Last spring a Geshe of my acquaintance, residing during the winter months at one of the places of pilgrimage in India, holy to Tibetan Buddhists, passed through Calcutta on his way to Lhasa on the occasion of his annual summer visit to Tibet. I met him and explained my wants, and he kindly promised to do for me what he could in this matter. Six months later he returned with two lists of Tibetan book-titles (one of which being, properly speaking, subdivided into two parts) altogether enumerating 219 titles He had kept his word splendidly and I think we have reason to be grateful for his kindness. I had explained to him the European conception of bibliography, but his lists did not, materially, come up to any ideal standard. Nevertheless they proved useful and rich in new names. His two (or otherwise three) lists are arranged as follows · One gives titles arranged under the names of printing establishments—and indicates the number of volumes of the single works. The second starts giving titles with the number of pages of each volume, but in the middle ceases to give these numbers, and so practically changes into a third list of titles only. Evidently verifying these numbers was a laborious work, and could not be completed before my friend left Lhasa again. So he brought the list with the page numbers filled in as far as they had been entered at the date of his return to India Both lists are written in Umed character. When I received them I went over them with my Tibetan teacher, collected notes about them, translated them into English, and made a number of cross-references to the few previously printed lists as far as they were at my disposal. The titles, as is common in all Oriental book-titles, bristle with flowery and allusive expressions, and contain a fair sprinkling of proper nouns and geographical names, which makes it impossible to render them with any degree of trustworthiness without the assistance of a Gegan (Munshi). It is therefore worth while to lay the result before others who may have to deal at one time or another with the same or similar titles, without the benefit of native help. I have consulted the other published lists and made some references to them, but I have neither amalgamated the common entries completely, nor made all the cross-references which it was possible to make

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[1] I possess, nevertheless, credible information leading me to expect that, with more intimate relations with the Tibetan authorities, astounding, agreeable, and important surprises may be in store for us in this direction.

The existing lists, like the present ones are all drawn up too briefly and summarily to justify as yet the compilation of a kind of Catalogus Catalogorum in connection with the three lists now presented. One of the previous lists gives no Sanskrit equivalents at all, even where these alternative titles are given in the books described. Another gives the original Tibetan titles only for some volumes and not for others. Another again transcribes only part of the titles, in arbitrary abbreviation, though the author has the actual books before him. My own lists are worse in a way, for they seem not even to have been copied from actual titles, however partially. I understand that they have been taken down from dictation, from memory, and represent the current popular names by which the books are referred to in Tibet. From the standpoint of scientific bibliography this may be sad, but from that of a study of the popular life it has its value. I do not think that the actual writers of the lists can have been very learned men ; they may have been practical booksellers Uncertainties like those offered by No. 116 (འདུ་ for འདུལ་, etc) seem to point to this conclusion. But it is certain that the lists embody an unusual amount of familiarity with book-names. I have not met with Tibetans who knew all these books, though several together knew most of them. It is also evident that the lists contain an appreciable proportion of new material. Further, it seems to me that the value of these lists lies is the fact that they give us a picture of the literature affected by the modern Tibetan intelligentsia. The Kanjur and Tanjur as such are excluded, but some parts of their contents are evidently still widely read and current in separate editions The number of works on grammar and poetics included is remarkable. These works seem to represent the class of literature in current demand by the educated and cultured Tibetan of to-day. The exceedingly numerous, in fact uncountable, little popular rituals, prayers, hymns, litanies and similar works which are to be met with in Tibet are altogether absent from our lists. Most of the works embody matter which lies at the root of Tibetan tradition and belief A fact which seems very significant to me is that we meet with several titles wholly identical with, or at least similar to, those published in the old lists of Schmidt, Böhtlingk and Schiefner, about three-quarters of a century ago. Literary taste does not seem to have changed much in Tibet during all that time Whether the cycle of Cathay will move as slowly in the future seems doubtful Already there are rumours of a telegraph line to Lhasa[1] Uniformed soldiers, postage stamps and even banknotes have already appeared in the land of Tsongkhapa. There was even a Lhasa Gazette is the most approved up-to-date style, though printed (lithographed) in Peking, which existed for about five years up to about the first year of the second Chinese revolution, and this བོད་ཡིག་ཕལ་སྐད་ཀྱི་གསར་འགྱུར་, of which I possess an almost complete copy, is a very curious production indeed. Yes, speaking about innovations, though unconnected with books, I may record stories of electric light in Lhasa in private houses of certain rich men and of a Russian diplomatic present to the Dalai Lama consisting of a gramophone praying the Aum Maṇi Padme Hūṁ. Whether these stories are true I do not know, but it seems certain that a few years ago an enterprising Nepali took a small cinema to Lhasa in order to make his fortune with it. But this was a failure, for the local wits decided that such things had never been spoken about in the Kanjur, and so they could not be. *They* were not to be had in this way. And our Nepali did not get any public to his magic exhibitions. The enterprise collapsed. To return: I have made a few references to the three earlier lists, mentioned above, in connection with some picturesque titles which reappear in our own lists after seventy-five years. It is scarcely necessary to add that bibliographical publications in Tibet are rare; booksellers' catalogues also. Only one item contained in our list seems to be a list of publications issued by a printing establishment (No. 144). As remarked *in loco* the existence of similar lists is not known to my informants, but in S C.D.'s list (A 44) we find what seems such a print, the དགའ་ལྡན་ཕུན་ཚོགས་གླིང་གི་པར་ཐོ་. Enquiry might lead to the discovery of others. On the other hand there are as a rule very good indexes attached to the separate volumes of the larger Sung-bums, or collected works, and the list of Schmidt and Böhtlingk enumerates a great number of indexes to various editions or manuscripts of the Kanjur and Tanjur (Nos. 262–284).

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[1] To-day the telegraph line has become a fact, and compliments have been exchanged over it between India and England, and Lhasa.

As to Tibetan bibliographical works, perhaps they exist In the list of Schmidt and Böhtlingk we find an entry, Nos. 446–456, entitled སློབ་དཔོན་བཞད་སྒྲུབ་མིང་ཅན་གྱིས་བརྩམས་པའི་དཔེ་ཐོ་རིན་ཆེན་འབྱུང་གནས་, "The book-list, called 'Source of Valuables' composed by the Teacher named Shä-dub." This seems a bulky work as it consists of eleven volumes. I have not been able to collect any information about it, and it may be that the title of the work is after all the most strictly bibliographical part of it. Yet until the work is found and examined the title holds out hopes.

As to the book trade in Tibet I have only meagre data. It is said that in Lhasa alone there are a score of book-shops or stalls, but none in Shigatse and Gyangtse. In the latter places books are sold by bagmen, pedlars, who usually carry about only cheap and popular prints. About the Lhasa book-bazar see Sandberg, Handbook of Colloquial Tibetan, p. 174. It is said that the larger books are never kept in stock printed, but are only struck off to order in as many copies as the customer needs. In Lhasa the book vendors undertake to procure prints from other, even distant, places. In Narthang alone, copies of the Kanjur and Tanjur are kept ready printed, but these ready copies are so abominably printed and inked, and their paper is so bad, that they are almost useless for reading. Most of the Narthang copies in libraries outside Tibet seem to be more or less of this kind.[1] The reason for this bad printing seems to be that by far the most of the customers do not require these collections for reading at all but for purposes of worship, for pustaka-puja. A cheap copy serves as well for this purpose as a better printed one. Book-shops in the European sense of the word do not seem to exist. The printing and publishing is mostly in the hands of the monasteries. Several of the larger monasteries have even several establishments connected with their various colleges, houses, or departments. The only more or less secular printing place seems to be that of the Potala Zhol, which is to a certain extent a government press, though not in the Western sense of the word; and which can only be described as secular in so far as government activities in an ecclesiastical state can be so termed. But besides the regular printing establishments in the monasteries, often sets of blocks, usually of only one or a few works of moderate length, may be found in the possession of rich men or aristocrats (which in Tibet is still often the same thing) who act either as patrons for some author (mostly a monk or other cleric) or have an old sacred text cut anew from motives of piety, or to acquire merit. The blocks of such works, produced by what may be called private enterprise, are either kept by the patron, or may be made over as a pious gift to some neighbouring monastery. In the cases in which the rich man keeps these blocks at home, the difficulty of storage and preservation, and the absence of skilled labour to produce prints, often leads to the blocks being forgotten, lost, or becoming inaccessible, and it may be believed that in this way a certain amount of literature is apt to disappear. Blocks are also sometimes cut at the chief expense of the richest patron with some little help from more modest contributors, in which case the chief patron, mostly, becomes the custodian of the blocks. In colophons, sometimes detailed data about such patronage may be found, carefully cut out in the last block after the close of the work. All printing in Tibet takes place during the summer, for the simple reason that in winter the ink freezes and printing becomes impossible. House heating for such purposes cannot be effected. In some large printing establishments the workers come together only during the summer printing season, to return to their villages or other dwelling places in the winter. There is a great variety of usage as to the way in which prints are obtained. Some monasteries possess blocks but no printers. In such cases the client has to bring not only his own paper and ink, but also his printers. He then has to obtain permission to use the blocks In other places the establishment has printers and furnishes paper and ink, unless the purchaser brings these with him to assure a certain standard of quality. In Narthang single volumes are not printed on special paper brought by the customer, but complete sets of Kanjur or Tanjur are executed on special paper if required The ordinary inking and paper there are most dismal. In some monasteries the prints are paid at the rate of a fixed price per 50 or 100 leaves, but in others the use of them is free after complimentary gifts to the monastery heads and tea offerings to the monks. To ensure good printing and inking, or the use of good paper, everywhere the personal factor comes into play, and a judicious outlay in tea and scarves, as well as some bakshish in various forms, is an almost indispensable element. It is said that printers are not above skipping batches of fifty pages or so in the middle of fat volumes They save themselves labour in that way, as also the money to be calculated for paper and ink Careful checking of any printed volume is, therefore, always necessary Besides this a thorough check has to be kept on the quality of the prints, as pages are often blurred and illegible. If these are found to be so, the customer may require them to be reprinted until they are satisfactorily executed. It will be seen that to get a book from a Tibetan press is a matter of considerable difficulty, and as to making a collection, it is an adventure calling for patience, persistence, keen watching and diplomacy.

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[1] See Beckh, Udānavarga, Preface, p. iv, note 2.

As to paper, that of Bhutan enjoys a specially good reputation, and as the blocks all over Tibet are equally good, the typographical result is largely dependent on the quality of the paper used. Consequently Bhutanese prints are generally very good, and indeed I possess a domang which is so well printed that it might be almost Chinese but for the fact that the paper is thicker and stiffer than that of Chinese books. Rich people like to furnish Bhutanese paper for their prints in Lhasa and other establishments. It is said that there is a specially fine copy of the Narthang Kanjur in Kalimpong on such paper, in the possession of one of the local nobles. This edition would probably be invaluable for text-critical work.

A few words must be said about the relation between manuscripts and prints In Tibet the position is analogous to that of Europe in modern times. As there, the printed edition usually represents the labour of expert and careful work: the block-cutter (equal to our compositor), the reviser (equal to our proof-reader), and in cases of very careful production even the editor, as with us In Europe printed books are practically no longer copied for home use, but in Tibet this is still done. The reason is almost invariably, either the impossibility of buying another copy of a coveted and valued book, as the book-trade is not organised and communications difficult, not to speak of the enormous distances, or the inability to pay for a printed copy because of poverty. Money is very scarce in Tibet. The result is that copying is almost invariably done by people less expert than the printers or the block-cutters working under expert supervision And in the case of those copying for reasons of poverty, they are often not the most learned and may even be really ignorant. Grammatical knowledge in Tibet is very limited and a science of the elect. Even professional copyists are better craftsmen than linguists or grammarians. Desgodins has made a very pointed remark about this.

But there is still another class of MSS. made for other than the two reasons given, and of quite a different character. These are those copied "in state" as it were, as works of piety. They are very ornate, mostly in gold or silver writing, or both, on dark blue polished thick paper, and make magnificent volumes, splendid examples of the calligrapher's art. Not all are so ornate. I have recently seen sample leaves of a Bum (the first sixteen volumes of the Prajñā-pāramitā) on stiff glazed white paper in black ink, in splendid writing, about a century old, an ideal copy to work on.[1] Most of these MSS. are chosen from the Prajñā-pāramitā class, and for smaller pieties the Vajrachedikā is the work most used, whilst for a middle-sized piety the Ashtasahasrikā ranks next in popularity. Also other books are chosen, and in the Victoria Memorial in Calcutta there is a fine copy in this manner of one of Padmasaṃbhava's works, I believe a བཀའ་ཐང་. I have also seen a still other variety of MSS., namely illustrated ones, with coloured figures of gods and tāntrik symbols, which cannot be produced in Tibet in that manner by print. All this does not exhaust the subject and can only serve as a very slight preliminary sketch of it.

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[1] Since acquired by the A.S.B.

Now we have still to consider the question of publishing or printing centres and the locality of the presses. Publishing in the European sense of the word is unknown in Tibet. No wholesale editions are ever printed off at once and distributed through selling agencies. As said before, the normal practice is to print each copy for the customer who wants it. An exception is formed by the small popular prints kept for sale by the little book stalls in Lhasa or those hawked about the country by bagmen. But even these are probably ordered by these booksellers in small batches and not kept in stock at the presses. Tibet is a country of travel and pilgrimage. A vast number of travellers are always on the road from the remotest corners of the country to its centre, Lhasa, and from there back again. These travellers, whether traders or monks, are the distributors of the printed literature. A man going to Lhasa, or elsewhere, may be commissioned by his friends to bring back such and such works, or having the opportunity at some monastery to acquire such works and having still room for an additional load on his yaks or mules, he may take books as balast, either for his own use or as a speculation. Often, also, a pilgrim may invest in a spare volume or two carried home on his back with his personal effects in the hope of some gain by their sale when he has returned to his dwelling place. From time to time I saw a few isolated volumes appear in this way on the benches of some shop in the Ghum bazar, which usually disappeared quickly. And then no one knew how they had come or when other copies would again arrive. This kind of book was usually not very valuable. Yet I have often picked up a stray volume in this way from passers through. Though publishing, then, in the stricter sense is unknown in Tibet, yet there is something that should be mentioned in this connection A number of books have been prepared for the press, that is their blocks have been cut and prepared in the printing places, which are only delivered to the specially privileged. There are such works as are judged in the eyes of the authorities to be unsuited to the masses and a special official permit is necessary to have them printed. The nature of these works is not well known to me. I believe they deal as a rule with the higher arcana of tāntrik philosophy. The matter deserves further investigation. For ordinary books no such permit is necessary. I think I remember rightly that in the index to one of the volumes of the collected works of one of the Teshu Lamas, the matter is divided into two parts. The second part of the index enumerates titles followed by a note to the effect that they are only printed on production of an official order. In the volumes delivered to the ordinary public the part corresponding to these titles is not included. In our lists here published 21 presses are named, but as they are practically all in Lhasa or in places along the road from India to Lhasa they can only represent an infinitesimal proportion of all the presses in Tibet and in the countries round Tibet where Tibetan is printed. Of Mongolia, Kashmir, Kham, China, practically nothing is said. Bhutan is reputed to have a great number of presses, with excellent prints, and with an extensive literature. The same is true for Kham, and especially Derge is famous for its many books, which are said to be specially well printed. It is even said that Derge boasts of sets of the Kanjur and Tanjur, printed from metal plates, a local stereotyping process. Derge is, further, renowned for its learned literature. Practically nothing is known to us about it. That Tibetan is printed in Peking we know and many will have seen several bilingual or trilingual Chinese prints. Then there are Kashmir or such centres as Kumbum at the other extremity of the country. We may expect to find a really astounding output in the whole realm. All of this relates more or less to lamaistic literature, whether religious or secular; mostly, of course, religious. But it is also said that there is a voluminous printed Bon literature about which practically nothing is known. Anyhow what has been mentioned is sufficient to show that literary discovery has still immense scope in Tibet.

The totals of our lists are as follows. The first list names 21 presses, and indicates 374 volumes. The number of leaves given in the second list comes to 4,017. The third list gives 74 titles. In all there are 219 entries, of which some are duplicates, and several are already known.

Below I give the names of the 21 presses enumerated in our lists, together with the few notes I have gathered about them They may serve as a preliminary reconnaissance in this field of enquiry.

With these general remarks everything has been said which I think relevant in introducing our lists. But in order to make this article more complete and useful. I will still add a summary of the chief material at our disposal concerning the Bibliography of Tibet, quite apart from the data furnished by these lists, and make a brief reference to the Tibetan books in Indian collections of which I have knowledge, as well as to some collateral matters of practical utility.

In his detailed and careful compilation on Tibet *Opisanie Tibeta* (Description of Tibet), Vol. II, Part I (Vladivostok, 1908), Prof Nikolai Kuehner deals with the same subject discussed by me above. Partly because his book, on account of the language in which it is written, is inaccessible to most Indian readers, and partly because it contains a few valuable additional data I here append what he says about Tibetan printing. The remarks form part of note 116 in the Appendix at the end of the volume, and are to be found on pp. 109 and 110. He writes :—

" Large printing houses are to be found in Lhasa, Narthang near Tashilhunpo, Kumbum and other monasteries of Tibet. Outside the country Tibetan books are printed in Peking (Sung-chu ssŭ), Urga, etc. In smaller printing houses, usually mere printing shops, only the common religious books and other works of small size are printed. In the larger establishments, too, usually the same kind of literature is dealt with, except when special orders are given.

In the time of the fourth Urga Khutuktu the Urga printing house began to cut the wood-blocks for a Tibetan Kanjur, and 72 volumes of the 108 were finished when at the death of Khutuktu the work was discontinued. So the Urga Kanjur remains incomplete till the present day (1892, the time when A. Pozdneyev visited Urga). Many of the blocks that had been prepared have since been damaged or lost. and others have become worn out through printing. The Urga edition of the Kanjur may therefore be regarded as non-existent, though some of the poor Khalkha monasteries buy it and complete the missing parts in writing.

The Urga printing house publishes also a few (not more than 20) small Mongolian books and a slightly greater number (about 50) of Tibetan religious books. Most of the books, however, published here are Lamaistic ritual works. (See Pozdneyev, Mongolia and the Mongols, Vol. 1, p. 86.)

The high cost of Tibetan works is chiefly caused by their length. Especially the collections of the Kanjur and the Tanjur are very bulky and represent quite a capital. (Cf. Wassiliev, Notice, etc., pp. 375-376.)

In most cases the purchaser who wants to buy a book, addresses himself to the nearest printing house where the blocks are kept of the book required by him, and orders a copy to be prepared for him. Kawaguchi acquired in this manner the greater part of the books he brought with him from Tibet. As he told Walsh (Walsh, List of Tibetan books brought from Lhasa by Ekai Kawaguchi, 119-120), he had always very carefully to check the number of pages as otherwise it is a very common form of fraud to leave out a large number of leaves."

The rest of Kuehner's note consists of extracts from Walsh's introductory note to the list quoted, which, as bearing on our subject is mentioned below in its place under II, III, 14, on p. 465. As this introductory note contains some details not reproduced by me above, the readers should consult it. He should likewise see Kawaguchi's remarks on books and printing in his "Three Years in Tibet" (Adyar, Madras, 1909), pp. 462-464.

II. THE BIBLIOGRAPHY OF TIBET.

All bibliographical literature about Tibet falls naturally under two main headings, the one treating of Tibetan works produced in Tibet, and the other of the study of Tibet by Westerners, be it scholars, travellers, missionaries or others. Under both headings important and numerous data can be entered. Arranging the available matter in tabular form the following scheme may be drawn up :—

I. Tibet General.

a. General Oriental Bibliography.
b. Special Chinese Bibliography.
c. Special Buddhist Bibliography.
d. Bibliographies in individual works on Tibet.

II. Kanjur and Tanjur.

a. Western Material.
b. Eastern Material.

III. Extra-canonical Tibetan literature.

IV. Collections and Book-sellers.

In this scheme the first division deals mainly with Western books, about Tibet, the second and third with the literature of Tibet, and the fourth gathers some practical information which here in India is often little known. It would not be necessary to include the first two divisions in the present paper at all, if experience did not teach that bibliographical knowledge, even amongst students, is limited in this country, and that for the simple reason that it is nowhere taught or studied in India, has no proper literary organs, and is not aided, as in Europe, by extensive library activity and the resources of great book collections with all the paraphernalia of indexing, cataloguing and reference, and above all expert guidance. Our best libraries in India are at most second-rate according to European standards, and few in number at that. Many small specialist libraries, excellent within narrow limits, are difficult of access beyond a restricted geographical area. And nowhere in India is there any library which can even remotely strive after the ideal of some degree of practical and well-balanced completeness. Great numbers of books on any given subject, which may be found in some library or other in even the smaller European countries, cannot be found in any accessible library in the whole of this gigantic continent; and the totality of India's book-wealth is so chopped up in small sections that it is often more practical to procure a work from Europe—with all the delays attendant on that procedure—than to waste time in often fruitless search along the many possible avenues of exploration leading to Madras, Bombay. Simla, Delhi, Lucknow, or wherever else. It is for the same reason that I mention the names of a few book-sellers specialising in Oriental Literature, contrary to the convention usually observed in learned journals.

I. TIBET GENERAL.

a. General Oriental Bibliography.

1. Orientalische Bibliographie (also with English title-page : Oriental Bibliography).

An annual bibliography, published in Berlin. Now in its third series. Originally started by C - Friederici as " Bibliotheca Orientalis," 8 vols., from 1876 to 1883; continued as " Literaturblatt für Orientalische Bibliographie," ed. J Klatt and E Kuhn, 4 vols., from 1883 to 1886 ; now " Orientalische Bibliographie," lastly edited bv Lucian Schermann, from 1887 The latest bound volume in the Imperial Library is Vol. 22, and contains the titles for 1908. Published in 1910. Since the outbreak of the war this indispensable work has ceased to appear but recently information has reached India stating that there is a probability of the resumption of its publication.

A separate special bibliography of works on Tibet does not yet exist. In the above work Tibet has a separate heading. The Imperial Library in Calcutta has a complete set of the third series ; the Adyar Library a nearly complete set of all the three series.

Nikolai Kuehner, of whose important compilation on Tibet, Opisanie Tibeta, Description of Tibet, the last part which has arrived in Europe is Vol II, Part 2, Vladivostok, 1908, has announced for Vol III of his work an " Essay of Tibetan Bibliography " It is not apparent that this volume has appeared or is about to appear soon or at all.

2. Recent works on Tibet are periodically recorded in the excellent subject indexes to the modern works added to the Library of the British Museum, of which the various volumes are dated 1902, 1906 (for 1901-1905), 1911 (for 1906–1910) and 1918 (for 1911–1915). In the Imperial Library.

b. Special Chinese Bibliography.

The older " Manual of Chinese Bibliography " by P. G. and O. F. Von Mollendorff, Shanghai, 1876, has a special section devoted to Tibet.

This work is now superseded by the " Bibliotheca Sinica," of H. Cordier, Paris, 1904–1907 (2nd edition), 4 vols., which in Vol 4 devotes about 68 columns to Tibet, and this part of the work constitutes in reality the fullest special Tibetan bibliography extant. In this work also the section Buddhism naturally contains much matter of interest to Tibetan students. A supplement to this work is now in progress of publication. Publisher Paul Geuthner, Paris. It is to bring the literature up-to-date to 1920. The second part of this supplement has appeared in 1923.

c. Special Buddhist Bibliography.

Of the older works the following may be mentioned :—

1. Otto Kistner. Buddha and his doctrines: A bibliographical essay. London, 1869.
2. Albert J. Edmunds. A Buddhist bibliography. Journal of the Pali Text Society. London, 1903.

Three recent works of great practical utility are :—

3. Hans Ludwig Held. Deutsche Bibliographie des Buddhismus. Munich-Leipzic, 1916 (2544 entries).
4. Ida A. Pratt Buddhism. A list of references in the New York Public Library. New York, 1916.
5. Dr. Hans Haas. Bibliographie zur Frage nach den Wechselbeziehungen zwischen Buddhismus und Christentum. Leipzig, 1922.

d. Bibliographies in individual works on Tibet.

1. Emil Schlagintweit. Buddhism in Tibet. (Bibliography. pp. 331–369.) Leipzic, 1863.
2. *Id.*, French translation by Léon Feer. Annales du Musée Guimet. Grande Bibliothèque, Série in 4°, Vol. 3. Paris, 1881.
3. L. A. Waddell. The Buddhism of Tibet (Bibliography, pp 578–583.) London, 1895.
4. Berthold Laufer. Verkürzte Version des Werkes von den Hunderttausend Nâga's. Helsingfors, 1898 (Memoirs of the Finno-Ugrian Society, Vol. XI) Bibliography, pp. 1–7.
5. Albert Grünwedel. Mythologie des Buddhismus in Tibet und der Mongolei (in the notes, behind, passim). Leipzig, 1900.
6. Sarat Chandra Das. Tibetan-English Dictionary. List of references on pp. xxvii-xxxii. Calcutta, 1902.
7. Berthold Laufer. Skizze der Mongolischen Literatur. In Keleti Szemle (Revue Orientale), VIII (1907), also separately printed.
8. Guenther Schuleman. Die Geschichte der Dalai Lamas. Heidelberg, 1911 (in footnotes, numerous references).
9. A Getty. The Gods of Northern Buddhism. Oxford, London, 1914. (Bibliography, pp. 183–186.)
10. Emil Trinkler. Tibet. Sein geographisches Bild und seine Stellung im Asiatischen Kontinent. Munich, 1922. (Contains an excellent geographical bibliography enumerating 362 items.)

These are some of the main works, giving rich bibliographical material. Nearly all that B. Laufer has written contains valuable matter of this nature; most of his works or essays furnish fresh data in this respect. Two classes of bibliographical material must be looked for in general geographical and missionary literature. I have no important references at hand for these, except No. 10. quoted above, though this literature should not be neglected.

(See Addenda, behind.)

II. KANJUR AND TANJUR.

a. Western Material.

1. Csoma de Körös. Analysis of the Kanjur and Tanjur in Vol. 20 of the Asiatic Researches the precursor of this Journal, Calcutta, 1836. (In various separate articles.)

Though better and more complete catalogues of the contents of both collections have been published since, and scientific detail has been attended to to a far greater degree than in Csoma's work, his catalogue is still the only one in any European language which not only enumerates but describes the contents of the first of these two large cyclopedias, the Kanjur, and as such his work with reference to the Kanjur is still almost as valuable as it was nearly a century ago on its appearance. In fact, in a way more valuable, because at present better use can be made of his data. His analysis of the Tanjur, on the contrary, is too brief and fragmentary to be of use.

2. This work was translated by Léon Feer, in Vol. 2 of the Annales du Musée Guimet, Paris, 1881. Feer, arranged the whole material in a practical way and added valuable indexes.

3. Index des Kandjur. Preface by I. J. Schmidt, Imperial Academy of Sciences of St. Petersburg. St. Petersburg. 1845.

A lithographic reproduction, in Tibetan character, of an indigenous index, without commentaries or translations. Copy in the Adyar Library.

4. Hermann Beckh. (Catalogue of the Kanjur.) Handschriften-Verzeichnisse der Königlichen Bibliothek zu Berlin. Vol. 24, Part 1 (Kanjur).

Detailed discussion and criticism of No. 4 in the next two numbers.

5. Paul Pelliot. Notes à propos d'un catalogue du Kanjur. Journal Asiatique, July-August, 1914, pp. 111–150. Paris, 1915.

6. Berthold Laufer. Tibetan Manuscripts (Book review). J.R.A.S., 1914, pp. 1124–1139.

7. P. Cordier. Index du Bstan-ḥgyur. Second and

third parts of the Catalogue of the Tibetan Collections of the Bibliothèque Nationale in Paris. **Paris, 1909 and 1915.**

The undertaking of which this work—a marvel of patience and care, and a monument to its author—constitutes only one half, remains unfinished. As practically adequate catalogues of the Kanjur already existed, the results of Csoma and Feer's combined labours, the author began his work with the Tanjur, intending to take up the Kanjur later. He fell, an early victim of the great war, after having only finished his work on the Tanjur. In India there are still old friends of this noble Frenchman who speak of him in terms of more than affection, loving the man as much as respecting the scholar.

8. Anton Schiefner. Ueber die logischen und grammatischen Werke im Tanjur. St. Petersburg (1847?). In the Bulletin de la Classe historico-philologique de l'Acad. Imp. des Sciences de St. Pétersbourg. T. IV. Nos. 18, 19. Also reprinted in the Mélanges Asiatiques of that body, and as a separate pamphlet.

9. Georg Huth. Verzeichniss der im Tibetischen Tanjur, Abtheilung mDo (Sûtra), Band 117–124, enthaltenen Werke. In the Sitzungsberichte of the Royal Ac. of Sciences in Berlin, 1895.

10. A brief supplementary note to No. 9, by the same Author, in Z.D.M.G., XLIX (1895). pp 279–284. Title: Nachträgliche Ergebnisse, etc.

11. Sarat Chandra Vidyābhuṣana Numerous articles in the J.A.S.B., New Series, mainly in Vols. 1–6, 1905–1910.

It will be seen from the above that we have at present only two easily accessible, satisfactory catalogues of the Kanjur and one only of the Tanjur. The enormous mass of material in the form of names of authors, translators, revisers, etc ; of countries, places, monasteries ; and of kings and other historical persons, mentioned in the pages of these volumes cannot be fully exploited until indexes to all of them have been made. Here is a true mine of treasure awaiting students. The numbers 8 to 10 all deal more or less with the same small group of volumes in more or less the same manner, and are largely superseded by No. 7.

Remarkable and very special contributions of value to the knowledge of the Kanjur are furnished by the two following :—

12. Berthold Laufer Die Kanjur-Ausgabe des Kaisers K'ang-hsi Bulletin of the Imperial Academy of Sciences of St. Petersburg. 1909, pp. 567–574.

13. Berthold Laufer. Dokumente der Indischen Kunst. Erstes Heft. Malerei Das Citralakshaṇa, Leipzic, 1913. (Specially: Introduction, pp. 49-62.)

14. Berthold Laufer. Descriptive account of the Collection of Chinese, Tibetan, Mongol, and Japanese books in the Newberry Library, Chicago, 1913.

Mainly about the Kanjur and Tanjur, but with some general remarks on Tibetan literature, pp. 6–12, and with further matter on the Chinese Tripiṭaka.

15. An article by "X" on The Tibetan Tripiṭaka, in the Imperial and Asiatic quarterly Review, 3rd series, Vol 28, 1909, (Woking), pp 335–337, seems hardly important enough to include it here. (See also Addenda, behind)

b. Eastern Material.

In the first place we have the Tibetan material, represented by the Tibetan Index published in St. Petersburg (see immediately above, *a*, No 3), as well as by the various other Tibetan indexes preserved in various collections and described in various lists. So for instance the several indexes to Kanjur and Tanjur in the St. Petersburg list of Schmidt and Böhtlingk (see below under III, extra-canonical literature), which cover 23 numbers. What these titles really represent is not at all sure as yet. The Schmidt-Böhtlingk list (Nos. 278–279) speaks of a Tanjur *printed* in Potala My informants maintain that such a Tanjur does not exist. They may be right or may be wrong, but the matter deserves inquiry. They explain the existence of several different Kanjur and Tanjur indexes by the statement that these refer to manuscript copies and not printed ones Whether true or not, the suggestion is interesting enough.

Next, the oriental material is represented by what can be learnt from the Chinese Tripiṭaka, because we may regard this as, in a measure, a Chinese equivalent of the Kanjur and Tanjur Most of our information about this collection is now derived from Western scholars, and they have certainly furnished the material most easily accessible and useable by Tibetanists, who may not know Chinese. So the matter is perhaps slightly out of place here under this heading If so, that may be forgiven. The following publications deserve mention, mostly available in India.

1. Samuel Beal. The Buddhist Tripiṭaka as it is known in China and Japan. A catalogue and compendious report. Devonport, 1876 Now superseded.

2. Bunyiu Nanjio A catalogue of the Chinese translation of the Buddhist Tripiṭaka, etc. Oxford, 1883. In the Imperial Library. This work contains a very detailed introductory essay on the bibliography of the Tripiṭaka in China.

3. E Denison Ross. Alphabetical List of the titles of works in the Chinese-Buddhist Tripiṭaka (Index to Bunyiu Nanjio and to the 1905 Kioto reprint). Calcutta, 1910.

4 Alfred Forke. Katalog des Pekinger Tripiṭaka. (Royal Library· Berlin.) Berlin, 1916. Describes a copy which, unhappily, is not altogether complete.

Next come the truly oriental catalogues, those contained in the Tokyo Tripiṭaka and in the Kyoto Tripiṭaka. The complete collections of the former edition (with the indexes) are in the Imperial Library and the Adyar Library. A large part of the latter edition (with the indexes) is in the Imperial Library.

It is further reported that the Calcutta University is arranging to acquire a copy of the recent Shanghai edition.

Of a practical catalogue raisonné of the Chinese Tripiṭaka, in ten volumes, entitled 閲藏知津, Yüeh-tsang-chih-ching, and mentioned by Nanjio in his introductory essay, several copies are in Calcutta, one in my own possession.

For the Pāli canon a reference to the publications of the Pali Text Society is almost sufficient. Of the King of Siam's edition there is a copy in the Library of the Calcutta University, one in the Adyar Library, and at least one in a private collection in the neighbourhood of Calcutta. Most of the publications of the Pali Text Society are to be found in the larger Indian Libraries, as also the recently started edition of the Pāli Tripiṭaka, printed in Singhalese characters, and published by the Trustees of the Simon Hewavitarne Bequest, Colombo

The recently published works on the history of Pāli literature contain also much information on this special subject Wilhelm Geiger's "Pāli Literatur und Sprache" (1916) is perhaps the most useful compendium.

Special reference should be made to a most valuable bibliographical essay dealing with the relation of the Āgama literature in Chinese and Pāli :—

Prof. M. Anesaki. The four Buddhist Āgamas in Chinese, a concordance of their parts and of the corresponding counterparts in the Pāli Nikāyas. In the Transactions of the Asiatic Society of Japan Vol. 35, part 3 Yokohama, 1908.

The bibliography of the Chinese Tripiṭaka, however, forms a special subject which cannot be pursued further at the present occasion.

III. EXTRA-CANONICAL TIBETAN LITERATURE.

1. Curiously enough, for so are the vicissitudes of human endeavour, the best and most practical contribution under this heading is one which has never been properly published, and which even lacks a title. It is a memorandum, addressed by Dr. F. W. Thomas, the Librarian of the India Office, to the Government of India, in connection with the political mission to Tibet, which was in process of being prepared in 1903. Dr. Thomas urged the importance of searching for Tibetan literary material on the occasion of the mission's visit to Tibet. The memorandum, dated January 18th, 1904, was followed by two important appendices. One gave a list of

hitherto published library catalogues of Tibetan books, and the other a list of titles of extra-canonical Tibetan books mentioned in such catalogues and in other works. This useful publication is still of practical value. A copy is to be found in the Imperial Library. Some of the under-following titles have been extracted from it, whilst I supplement some items which were not contained in the memorandum, and others which refer to publications subsequent to its appearance.

2. According to Waddell, as mentioned in the introduction to his list (see No. 16 below), Professor C. Bendall addressed a similar memorandum to Government. I have not been able to obtain or see a copy of this and consequently ignore whether it contains bibliographical information.

3. I. J. Schmidt and O Böhtlingk. List (Verzeichniss) of the Tibetan MSS. and Xylographs in the Asiatic Museum of the Imperial Academy of Sciences, St. Petersburg.

Published in the Bull. hist -philol. Vol. IV., Nos. 6, 7, 8. Reprinted separately [1846].

A. Tibetan works, 520 entries.
B. Tibeto-Mongolian and Tibeto Mongolian-Chinese works, 43 entries.
C. Duplicates, 141 entries.

4. A Schiefner. Addenda (Nachträge) to the above. Same Bulletin, Vol. V, No 10, reprinted separately without date (about 1848). 58 entries.

5. A. Schiefner. Report (Bericht) about the latest consignment of books from Peking. Same Bulletin, Vol. VIII, Nos. 1 and 2. 1851. Reprinted separately.

1. Works relating to India [in Tibetan], 11 entries.
2. Tibetan works, 43 entries.
3. Tibetan works with translations. 3 entries.
[4 Manchu works, 12 entries.]

Nos. 3–5 together constitute a collection of the greatest importance. It is reported that since the issue of the latest list, of 1851, an enormous amount of additional material has accumulated in the St. Petersburg Institution. but no further catalogues of the new acquisitions have appeared. The above lists all give full Tibetan titles, together with a German translation of them, and if present, the equivalent Sanskrit titles.

6. Catalogue of the Books and MSS. in the Chinese, Manchu, Mongolian, Tibetan, and Sanskrit languages, in the Asiatic Department, St. Petersburg, 1844.

Number of entries for Tibetan not given; reference taken from Dr. Thomas' list.

7. Emil Schlagintweit. Catalogue of Tibetan MSS. in the Royal Library, Munich (Die tibetischen Handschriften, etc.),

In the Abh. of the Phil.-Hist. Class I of the Bavarian Academy (Munich, 1875). Reprinted separately. 48 entries.

8. Emil Schlagintweit. List of Tibetan MSS. in the Wurtemburg State Library in Stuttgart (Verzeichniss)

In the transactions of the philos-pilol. and hist. class of the Munich Academy, 1904, pp 245–270. Reprinted separately. 22 entries.

9. Emil Schlagintweit [?]. List of MSS. collected by his brothers and incorporated in the Bodleiana in Oxford.

Schlagintweit (Bericht über eine Adresse, etc., p. 659) states that his brothers brought home 101 Tibetan items from Buddhist monasteries in the frontier regions of Central Tibet "A detailed description is in preparation" (1904). Laufer (Ein Suhngedicht der Bonpo, p. 1, 1899) mentions a 'short lithographed list' of these: "Tibetan Manuscripts, Schlagintweit Collection." Mr. A. Cowley, of the Bodleian, had the kindness to inform me in 1918: "We have a lithographed copy of a catalogue of the Tibetan MSS. bought from Dr. Schlagintweit, but we have no spare copy which we can send."

10. Lama Phun-tshog Wangdan. A catalogue of Tibetan Block-prints and Manuscripts brought from Tibet, by Çri Sarat Chandra Das in 1879 and 1882.

A footnote says: This list was first made in May 1886 by Lama Phun-tshog Wangdan.

Date and place of issue are not given. It is not evident that this important list has been officially published. Probably Sarat Chandra Das distributed it privately to his literary friends.

The list is divided into two portions, enumerating 165 and 42 numbers, 207 in all The 42 works of the second portion are said to be in the library of the Government High School at Darjeeling. In a note in Schlagintweit's Bericht, quoted above, it is said that the other 165 works are in Calcutta The majority of these have since found a permanent place in the Library of the Calcutta University.

It is a strange coincidence that this very valuable list has remained as hidden to the general public as Dr. Thomas' Memorandum.

11. P. Ghosha. A nominal list of Tibetan Manuscripts and Xylographs in the Library of the Asiatic Society of Bengal. No date. A very imperfect and incorrect hand-list.

177 entries of which the first 120 seem to refer to the Kanjur.

12. H. Wenzel. List of Tibetan MSS. and printed books in the Library of the Royal Asiatic Society (of London).

J.R.A S., 1892. (New S. 24, pp. 570–9.)

29 MSS., 18 prints; many incomplete and fragmentary.

13. Berthold Laufer. List (Verzeichniss) of the Tibetan

MSS. in the Royal Library in Dresden. Z.D.M G., 1901, pp. 99–128. 138 entries.

14. E. H. C. Walsh. A List of Tibetan books brought from Lhasa by the Japanese Monk, Mr. Ekai Kawa Goohi. J.A.S.B., Vol. 73, Pt. I. pp. 118–177, 1904.

81 entries, of which several sub-divided.

15. Tsibikov. Musei Asiatici Petropolitani Notitiæ, IV, 1904. (Tsibikov and Stcherbatskoi) No number of entries. (From a MS. Note in Dr. Thomas' Memorandum.)

16. L. A. Waddell Tibetan Manuscripts and books, etc., collected during the Younghusband Mission to Lhasa. The Imperial and Asiatic Quarterly Review and Oriental and Colonial Record. Third Series, July 1912, Vol. 34, No. 67, pp. 80–113. 464 entries

17 M.M Haraprasad Shāstrī Catalogue of Manuscripts in the Bishop's College Library, Calcutta, 1915.

Contains 21 Tibetan numbers (101–121), some of which are prints, and 8 numbers (49–53; 56–58) containing the remains of the important lexicographical material compiled by the old Catholic Missionaries in Lhasa, having passed through the hands of Major Latter and the Missionary Schroeter. Partly in Italian, partly in Indian vernaculars.

The following three items are of lesser importance.

18. Csoma de Körös, Enumeration of Historical and Grammatical works to be met with in Tibet. J A.S.B., Vol. VIII, 1838, pp 147–52. Reprinted by E. D Ross, J.P.A.S.B., N.S., Vol. 7, extra No 1, 1912; also Csoma's Grammar, pp. 179–180.

19. Bernh. Dorn Das Asiatische Museum der Kaiserlichen Akademie der Wissenschaften zu St Petersburg. St. Petersburg, 1846. " Mentions a very few works."
(From Dr. Thomas' Memorandum.)

20. Catalogue of Oriental MS. and Xylographs of the Imperial Public Library of St. Petersburg (Bibliothèque Impériale, Catalogue, etc) St. Petersburg, 1852. Enumerates only ten items, mostly of only a few pages, and without importance. The only interesting entry is the one mentioning the famous leaf found in 1777 in Siberia, on which Bayer misspent so much labour.

Mention must also be made of :

21. Wassiliew. Die auf Buddhismus bezüglichen Werke der Universitäts-Bibliothek zu Kasan, Bulletin of the St. Petersburg Academy, Vol. XI and Mélanges Asiatiques, Vol. II, pp. 347–86. St. Petersburg. Also reprinted separately More a literary than a bibliographical essay; yet valuable.

In addition to the above I have met with two titles which seem to refer to other publications than any of the above :—

22. Catalogue of the Sanskrit, Mongolian, Tibetan, Manchurian and Chinese books and MSS. preserved in the library

of the Imperial University of Kasan, (in Russian), Kasan, 1834. Quoted by Laufer in his sketch of Mongolian Literature, p. 166. (This is not the same as No. 21, and the list does not seem to be mentioned anywhere else.)

23. Wassiliew Notice sur les ouvrages en languages de l'Asie orientale que se trouvent dans la Bibliothèque de l'Université de Saint-Pétersbourg, 1856. (From Geuther's Ephémérides, 65 March, 1923.) It is not evident, however, whether this list contains any Tibetan titles.

Scrutinising the above lists, we find that the bulk of important information and material is contained in Nos. 3, 4, 5. 10, 14 and 16. Nos. 6, 15, 19 and 20 are little accessible, and Nos. 6, 9, 15 and 21 may contain some important titles. The old St Petersburg lists and No. 14 are most satisfactory to deal with, as they give the titles in full, in correct transcription. Waddell's list is curiously inequal, giving full details for some titles and only summarised translations for others. Wangdan's titles are written with oriental freedom. Walsh has, unfortunately, given no attention whatever to the relation of his works to Sanskrit literature The descriptions in No. 17 are insufficient and the list only serves as an indication of the existence of the works it mentions. My own titles are insufficient for strict bibliographical purposes Whether the time has arrived to amalgamate all these titles into a small Catalogus Catalogorum may be doubted.

Nevertheless the totality of the data furnished by our lists brings ample material and is sufficient to indicate the richness of Tibetan extra-canonical literature, opening vistas in many directions. It is probable that the various collections described in the lists quoted do not exhaust by any means the bulk of Tibetan literature collected in public or private libraries. It is highly desirable that an attempt should be made to ascertain where other collections may be found. European, American and Japanese scholars might well give this matter some attention. Here in India information on that point can be gathered only with great difficulty. In bringing to an end this section of my paper I wish, for completeness' sake, to make special mention of a bibliographical article describing some of the old lexicographical MSS. in the library of Bishop's College, Calcutta, more fully and correctly than in the catalogue quoted above as No. 17. The fascinating essay telling all about these old Tibetan MS. dictionaries is :

24. Rev. Father Felix, O.C. Remarks on the Tibetan Manuscript Vocabularies in Bishop's College, Calcutta. J.A S B., New Series, Vol. VIII, 1912, pp. 379–397.

IV. COLLECTIONS AND BOOKSELLERS.

a. Collections.

It is known that greater or lesser collections of Tibetan books are in the possession of many of the well-known Tibetan scholars whose names are familiar to students of Tibetan matters. References to such collections have been made in connection with the names of Prof. Grünwedel in Berlin, M. Jacques Bacot in Paris, Dr. B. Laufer in Chicago,[1] Dr. H. Hackmann (see the illustration in his "Von Omi bis Bhamo"). The Moravian Missionaries from Ladakh, Dr. H. A. Francke, Mr. S Ribbach and others, probably have gathered interesting material. Sir Claude A. Bell, late Political Resident in Sikhim, is reputed to have a very rich collection. Most of Waddell's and Schlagintweit's books seem to have passed into the possession of public institutions. I myself possess a collection of slightly over a thousand numbers, half MSS. and half prints. In Darjeeling a brisk trade is being done in ornamental MSS. of Prajñāpāramitā texts, mostly Aṣṭasāhasrikās, written in gold or silver. Rich globe-trotters carry them off to all parts of the world, and probably not a few have found their way to America. I may mention here that as sellers and buyers of such books are usually little aware of the nature of their contents it has happened that a three or four volume MS. of the Pañcaviṃśatisāhasrikā has been impartially sold to, and carried off by, different purchasers, volume by volume I was offered Vols. II and III of such a MS., of which the first volume had just been acquired by a London commercial magnate. Many missionaries must undoubtedly have brought books with them to Europe, either from the Chinese frontiers, or from Ladakh or Sikhim. The Vatican should possess some curious relics of former missions, as well as, perhaps, more recent material. The headquarters of missions operating on the borders of Tibet, whether Moravian, Scandinavian, American or Roman Catholic are sure to have some collections.

As far as public collections in India are concerned I know of the following:—

1. The Asiatic Society of *Bengal*, Calcutta. Complete Kanjur and Tanjur, and some 50 extra-canonical works, and the MS. Bum referred to above.

2. The Calcutta University. A Kanjur and Tanjur. An excellent MS. of the first three Pāramitā texts, a so-called Bum, 16 vols. The bulk of Sarat Chandra Das' private

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[1] Laufer in his sketch of Mongolian Literature, quoted above, states, p 165–166, that his private library of Mongolian and Tibetan prints contains about a thousand volumes. "Zur Förderung der tibetisch-mongolischen Studien bin ich jeder Zeit gern bereit, Fachgenossen Werke aus dieser Sammlung zur freien Benutzung zu übersenden."

collection, and a hundred various volumes as below, together with some further material.

Recently increased by a very valuable collection of another hundred volumes brought from Lhasa, and some time before that by a copy of the རིན་ཆེན་གཏེར་མཛོད་, Precious Treasury (of the religious literature of the different Nyingmapa sects), in 63 vols. It is said that there are in Tibet five such religious miscellanies or cyclopedias of which this is one; each restricted to the writings of a particular sect, or rather group of sects. The saying is མཛོད་ཆེན་རྣམ་པ་ལྔ་; there are five different religious treasuries. Together they comprise about 200 volumes. One is devoted to Gelukpa matter one to the Nyingmapa, one to the Kagyüpa, one to the Sakyapa and one to general knowledge. They were collected together by a famous Tibetan encyclopedist, ཀོང་སྤྲུལ་ཡོན་ཏན་རྒྱ་མཚོ་, who lived to the ripe age of 86 and died about 30 years ago. He lived in Kham, Derge, where this colossal work was published. A second edition of the Nyingmapa part only was in recent times completed in སྟོད་ལུང་མཚུར་ཕུ་. A short biography of this remarkable Tibetan polygraphist exists.

3 The Imperial Library, Calcutta, about a hundred volumes, as above, comprising the complete works of the first five Teshu Lamas, of Tsong-kha-pa and his two pupils (Gyal-tshab-rje and Mkhas-grub-rje), further of Atīsha, Brom-ston, Dge-ḥdun-grub, some 15 volumes of Nyāyā texts, the works of four Yongdzins or Lama-teachers, and some minor works.

4. The Adyar Library, Madras. A Kanjur and Tanjur and half a dozen other works.

5. The Bangiya Sahitya Parishad, Calcutta. A Tanjur.

6. The Victoria Memorial, Calcutta. A few ornamental MSS, gold or silver on blue, probably Padmaistic works.

7 Bishop's College, Calcutta. About 29 works as indicated and commented upon above

There may be other public collections in India of which I am not aware. All the Kanjurs and Tanjurs mentioned above are Narthang prints. Some are exceedingly badly legible, and the multiplicity of copies in India is in no way excessive. In most cases all available prints are necessary to arrive at a satisfactory reading of any consecutive text, and even that is not always possible with the means at our disposal here

Mention must be made of the curious history of two Tibetan works brought to Calcutta in the time of Warren Hastings.

8. Gaur Dás Bysack. Notes on a Buddhist Monastery at Bhot Bágán (Howrah), on two rare and valuable Tibetan MSS. discovered there, etc. J.A S.B., Vol. 49, Part I, for 1890 (1891), pp 50–99, with two plates.

See also Proceedings of the A.S.B. for January 1889, pp. 8–12, on this subject.

Besides the above collections in European and Indian hands, there are, of course, the monastery and private collections in Ladakh and in and around Sikhim Bhutan, being practically inaccessible, need not be mentioned. Ladakh is rather out of the way for most students, but Darjeeling and its neighbourhood are next-door to Calcutta

In the Darjeeling, the Ghoom and the Gying (གྱིང་) monasteries (the two latter each a few miles from Darjeeling) there are Kanjurs (Narthang), but no Tanjurs. In the Kalimpong monastery there is only a Bum. In the Sikhim monasteries there is said to be material which it would be worth while inventarising, but we do not know much concerning it A literary survey of the Sikhim monastery-libraries would seem useful, but on the other hand, might lead to disappointment.

In the Nepalese Durbar Library at Katmandu (or in another library in that place?) there is at least a Tanjur, and this copy seems to be another than the Narthang print as it does not contain a certain text incorporated in this

b. Booksellers.

In contradistinction to the situation in India where organised book-trade for scientific purposes is still in a primitive stage with the exception of a very few laudable exceptions, and where a really helpful second-hand trade in Oriental books simply does not exist, in Europe there are several highly specialised firms. with ample resources and in possession of rich stocks of works. These firms, equipped with competent staffs in possession of considerable practical knowledge of Oriental bibliography, have become the indispensable helpers of the student, who without their assistance would be very helpless indeed. In India, amongst Oriental scholars, there is as a rule still too little contact with such book-agencies in Europe. It would be impossible to give, or even attempt to give, a complete list of such firms, but I may name a few who are particularly useful in connection with books on Orientalism in general, or those on Tibet in particular. In fact the activity of several of these firms may be rightly described as a practical branch of Orientalism, in the same sense as science is classed as Pure and Applied, without difference in principle.

In England :

Luzac & Co., Oriental and Foreign Booksellers, 46, Great Russell Street, W.C. 1.

Issue a very instructive "Luzac's Oriental List and Book Review" (1922, Vol. 33), and periodically catalogues of second-hand books amongst which a Bibliotheca Orientalis of which about 25 numbers have appeared.

Probsthain & Co. (J. Murray-Wood), Oriental Booksellers, 41, Great Russell Street, London, W.C. 1.

Issue second-hand catalogues. Latest Oriental Catalogue, No. 33.

E. L. Morice, Museum Street, London, W.C.

Used to specialise in Chinese and Central-Asian literature, issuing useful catalogues. Has died, and his stock has been acquired by Messrs Kegan Paul, Trench, Trübner & Co., Ltd., 39, New Oxford Street, London, W.C.

Bernard Quaritch, Ld., 11. Grafton Street, New Bond Street, W. 1, London.

Specially useful for rare works and MSS., old editions and preciosa generally. Most sumptuous catalogues (present number past 370).

Francis Edwards, 83 High Street, Marylebone, London, W. 1.

Frequent catalogues, specially rich in recent literature relating to India, No. 437 in November, 1922.

John Grant, Bookseller, 31, George IV Bridge, Edinburgh. Frequent Orientalia.

B. H. Blackwell, Ltd., 50 and 51, Broad Street, Oxford.

Frequent catalogues.

John M. Watkins, 21, Cecil Court, Charing Cross Road, London, W.C. 2. Specialises in mystical and philosophical lecture of East and West, Catalogues.

W. Heffer & Sons, Ltd., Cambridge England Specialise in "Remainders," but also publish a "Bibliotheca Asiatica" (of second-hand books), of which the 13th Number was published in 1923.

Henry Sotheran & Co., 43, Piccadilly, London, W. 1. Latest catalogue No. 75. Occasional Orientalia.

In France :

Paul Geuthner, 13 rue Jacob, Paris VI^e

Issues valuable "Éphémérides," latest issue No. 65. Both new and second-hand Orientalia.

In Germany :

Otto Harrassowitz, Leipzig, Querstrasse 14. Used to issue, before the war, most valuable "Berichte," which lately have been in suspense. Has issued a profusion of catalogues, mostly on Orientalia (No. 393 in 1923). Latterly these catalogues have been less frequent.

Karl W. Hiersemann, Königstrasse 29, Leipzig.

Valuable catalogues; about 500 issued.

Joseph Baer & Co., Frankfort am Main. Hochstrasse 6. Not specially Orientalising, but occasionally issuing good catalogues on Oriental subjects. About 700 numbers to date.

In Holland:

E. J. Brill, Oude Rijn, Leiden. Especially strong in literature relating to the Dutch-East-Indies and Mohammadanism, but also general Orientalism.

Latest second-hand catalogue No. 75

Martinus Nijhoff, Lange Voorhout 9, The Hague.

About 500 catalogues issued.

Most of the firms mentioned above are not only dealers in second-hand books, but also general booksellers and in many cases publishers.

It should be distinctly understood that mention or absence of mention of any name in the above list or the order of sequence in it does not involve any appreciation as to standing, capacity or value of any firm. The names I have mentioned are those with which I happen to be familiar and with which I have had dealings during a quarter of a century of book-buying. Personally I owe those firms no little help in my own private studies. Others must have been equally benefited, but may have chanced on other firms. Here in the East as probably in all colonies and extra-European countries, we are only very incompletely and haphazardly informed about the practical help we, as students, could derive from the book-trade, which in Europe has reached such a high level. That is a great pity, and not a little to the detriment of our studies. About the second-hand book-trade of America, Russia, the Scandinavian and Latin countries of Europe, Switzerland, Belgium and Austria, as also of the Far East,[1] we are very badly informed. I would suggest that all Oriental booksellers should consider the advisability of issuing a collective brief annual publication, containing a bare list of their names and addresses, together with a description of their periodical publications such as Catalogues, Notices, Journals, etc., and a brief few-line indication of their specialities. That would benefit trade as well as scholarship and introduce much-needed system in the present exceedingly haphazard relations between the second-hand book-trade and study.

As there does not exist any publishing-house specialising in new publications on Tibet, the trade in new books is altogether left out of consideration in the above.

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[1] Recently a Chinese Monk has founded an "International Buddhist Book Depot" first in Calcutta, now in Rangoon. His name and address are Rev. S. Wan Hui, Post Box No. 971, Rangoon. His aim is to be an intermediary between Buddhists in the East and Western books on Buddhism on the one hand, and between Western scholars and Eastern Buddhist books on the other.

III. LIST OF TIBETAN PRESSES.

In order not to swell the bulk of this article too much I refrain from giving here references to works about Lhasa and Tibet generally, which would furnish additional information about the presses mentioned. I only note down the oral information received from my informants.

1. ཀུན་བདེ་གླིང་. Gelukpa. In Lhasa. Press of the གྲྭ་ or school of that name. About 100 tapas.

2. བསྟན་རྒྱས་གླིང་. Gelukpa. In Lhasa. Press of the གྲྭ་ཚང་ of that name. About 170 tapas. It has been reported that this monastery had been altogether devastated by the Chinese during the troubles of about 14 to 12 years ago, when the Dalai Lama fled to India. The rich collection of blocks was said to have been utterly destroyed. But this report seems incorrect. It refers probably to the destruction of the blocks of the གཡུ་ཐོག་ press, a private establishment, and of another private press the ཟུར་ཁང་ Of this last press most blocks have been cut anew and so have been replaced.

3. རྡོར་བྲག་. Nyingmapa. About one day south of Lhasa. Number of inmates unknown.

4. གནམ་འབྲུག་དགོན་ Kagyüpa. ལྷོ་ཁ་, Bhutan. No details.

5. ཞོ་དྲ་ལ་ཞོལ་ In Lhasa. In the basti under the Potala palace. Described as the only large 'secular' or 'official' (i.e. run by the government) printing place in Tibet.

6. ཕུར་ལྕོག་རི་ཁྲོད་ Gelukpa. In Lhasa. The monastery of the late teacher, or Yongdzin (now dead), of the present Dalai Lama. About 50 to 60 tapas.

7. བྲག་ཡང་རྫོང་ Sect and number of tapas unknown. South of Lhasa. Distance unknown.

8. འབྲས་སྤུངས་སྒོ་མང་ Gelukpa. One of the many presses

of the separate colleges (གྲྭ་ཚང་) in Däpung. Lhasa. About 200 to 300 tapas.

9. འབྲས་སྤུངས་གཙང་པ་ Gelukpa. Lhasa. The college for the people from Tsang (གཙང་པ་ཁམས་ཚན་) About 100 to 200 tapas.

10. འབྲས་སྤུངས་སྤྱིའི་སོ་ Gelukpa. Lhasa A press which serves the interests of the Däpung monastery as a whole (སྤྱི་ = general), and not any individual college

11 འབྲས་སྤུངས་བློ་གླིང་ Gelukpa Lhasa. From 500 to 600 tapas.

12. འབྲས་སྤུངས་སྒོམ་ར་ Gelukpa. Lhasa. 100 tapas.

13. འབྲས་སྤུངས་ཚོགས་ཁ་ (or ཚོགས་ཁམས་ཚན་) Gelukpa. Lhasa. 100 tapas.

14. འབྲས་སྤུངས་ཧོར་ Gelukpa. Lhasa ཧོར་ཁམས་ཚན་ 100 tapas

15 ཚེ་ཚོག་གླིང་ Gelukpa. Lhasa. 100 tapas

16. མཚུར་ཕུ་དགོན་ (=སྟོད་ལུང་མཚུར་ཕུ་) Kagyupa. One day North of Lhasa Number of tapas unknown.

17. འོད་ཀ་སྣ་ཡུང་ (= འོལ་ཁ་སྣ་ལུང་ ?) South of Lhasa. No further details.

18. འོན་རྒྱལ་སྲས་ South of Lhasa. No details. (འོན་རྒྱལ་སྲས་ seems not to be the real name of the monastery, but that of its presiding incarnation).

19. གཞིས་སྡེ་ Gelukpa. Lhasa. 200 tapas.

20. སེ་ར་སྔགས་པ་ Gelukpa Lhasa. The Sera tāntrikas. 1,000 tapas.

21. ལྷོ་ཉན་དྲི་ལེགས་ Sect unknown. About three days south of Lhasa. No further details. This name seems doubtful, might be ལྷོ་གཞལ་, the name of a district.

IV. TEXT OF THE BOOK LISTS.

ལྷ་ལྡན་དང་པན་ཚུན་དུ་དཔེ་ཆ་པར་ཇི་ཡོད་ཀྱི་ཐོ།

འབྲས་སྤུངས་བློ་གླིང་པར་ཁང་དུ།

1	པར་ཕྱིན་དབུ་མ་ཐལ་སྒྲོད་	༡
2	ཚད་མ་རྣམ་འགྲེལ་	༡
3	འདུ་བའི་ཞི་སྟོད་ཞི་སྨད་	༢
4	གྲངས་ངེས་ཐལ་སྒྲོད་	༡
5	དབུ་མའི་ཟིན་བྲིས་	༡
6	དབུ་མ་རྩ་ཤེལ་གཞུང་འགྲེལ་	༡
7	པར་ཕྱིན་སྤྱི་དོན་	༡
8	པར་ཕྱིན་རྩ་ཊཱིཀ་	༡
9	པར་ཕྱིན་ལམ་ཁྲིད་	༡

འབྲས་སྤུངས་གཙང་པ་ཁམས་ཚན་པར་ཁང་དུ།

10	འདུ་བའི་སྡོམ་ཚིག་རྒྱས་བསྡུས་	༢

སྒོམ་ར་པར་ཁང་དུ།

11	བྱམས་ཆོས་སྡེ་ལྔ་	༡

འབྲས་སྤུངས་པར་ཁང་ཆེན་མོ་ལ།

12	རྒྱལ་བ་ལྔ་པའི་གསུང་འབུམ་	༢༡

13	རྒྱལ་བ་བསྐལ་བཟང་རྒྱ་མཚོའི་གསུང་འབུམ་	༦
14	རྒྱལ་བ་དགེ་འདུན་གྲུབ་གསུང་འབུམ་	༤
15	དགེ་འདུན་རྒྱ་མཚོའི་གསུང་འབུམ་	༣
16	ལྕང་སྐྱ་ངག་དབང་ཆོས་ལྡན་	༤
17	མཛོད་བརྒྱ་དཔག་བསམ་འཁྲི་ཤིང་	༡
18	བཀའ་གདམས་ཕ་ཆོས་བུ་ཆོས་	༢
19	རྒྱལ་བ་རིམ་བྱོན་རྣམ་ཐར་	༤
20	རྗེ་བཙུན་འདིང་མ་པའི་རྣམ་ཐར་	༣
21	དུས་འཁོར་དྲི་མེད་འོད་རྒྱན་	༡
22	སྨྲུན་ཕྱ་བློ་གྲོས་རྒྱལ་མཚན་	༣
23	བཞུ་འབུམ་སྟོན་པོའི་འགྲེལ་པ་	༡
24	རྒྱ་གར་ཆོས་འབྱུང་	༡
25	སྒྲ་ཀ་ལ་པའི་སྲུས་རྟགས་	༡

སྒོ་མང་པར་ཁང་དུ།

26	བཀའ་པོད་ལྔའི་འགྲེལ་པ་	༡
27	འདུ་ར་བཀའ་གདམས་སྤྱི་འདུས་	༡
28	རྗེ་རྣམ་ཐར་	༡
29	གྲུབ་མཐའ་ཆེན་མོ་	༡
30	དབང་ཆེན་བརྒྱ་རྩ་	༦
31	ཟུར་ཁ་བརྒྱ་རྩ་	༡

32	གྲང་ངེས་ཞི་འགྲེལ་	༡
33	བཀའ་འགྲེལ་	༡
34	སྤྱོད་འཇུག་འགྲེལ་པ་	༡
35	ཆོས་ཚན་བཅོ་བརྒྱད་	༡

ཧོར་མི་ཚན་པར་ཁང་དུ།

36	ལམ་རིམ་ཆེ་ཆུང་	༢
37	ཁྲི་ཆེན་གསུང་འབུམ་	༡

ཚོགས་ཁ་མི་ཚན་པར་ཁང་དུ།

38	ཨེ་ལྷ་མའི་གསུང་འབུམ་	༢
39	དམིགས་བརྩེ་མའི་ལས་ཚོགས་	༣
40	བཀའ་གདམས་གསུང་ཐོར་བུ་	༡
41	ཕར་ཕྱིན་སྐབས་དང་པོ་	༡
42	མགྲིན་སྔོན་ཟླ་བའི་རྟོགས་བརྗོད་	༡
43	མ་ཎི་བཀའ་འབུམ་	༡
44	སྙིང་ཐིག་	༥
45	ཐ་སྤྱུབ་	༣
46	དགོངས་པ་ཟངས་ཐལ་	༣

སེ་ར་སྔགས་པ་ཁང་སེར་པར་ཁང་དུ།

47	ནམ་མཁའ་བསྟན་སྐྱོང་	༡
48	ཆུ་བཟང་གསུང་འབུམ་	༡

49 གསན་ཡིག་ ༡

50 ཁྲི་རིམ་བྱིན་གསུང་འབུམ་ ༨

51 ངག་དབང་ཆོས་རྗེའི་མཛོད་གནས་པོད་ ༡

52 ལྷུང་སྐྱ་གྲུབ་ཐ་ ༡

53 ཀེ་ཚང་འཇམ་དབྱངས་གསུང་ ༢

ཕུར་ལྕོག་པར་ཁང་དུ།

54 ངག་དབང་བྱམས་པའི་གསུང་ ༣

55 ཁ་རྡོ་བཟོད་པ་རྒྱ་མཚོའི་གསུང་ ༡

ཞོལ་པར་ཁང་དུ།

56 སྡེ་སྲིད་གསུང་འབུམ་ ༡

57 བཻ་དཀར་རྩིས་ ༡

58 བཻ་སེར་ ༡

59 གཡའ་སེལ་ ༡

60 བཻ་སྔོན་ ༨

61 ཀླུ་འབུམ་དཀར་ནག་ཁྲ་གསུམ་ ༣

62 རྒྱུད་བཞི་ ༡

63 ལྷན་ཐབས་ ༡

64 རྩིས་ཡིག་པད་དཀར་ཞལ་ལུང་ ༡

65 རྒྱུད་བཞིའི་འགྲེལ་པ་ ༡

66 མགོ་པོའི་ཞལ་ལུང་ ༨

67	དབྱངས་ཅན་སྒྲ་མདོ་	༢
68	སྒྲ་པ་ནི་	༡
69	གསེར་གདུང་རིན་པོ་ཆེའི་དཀར་ཆག་	༡
70	བཀའ་ཐང་སྡེ་ལྔ་	༡
71	བཀའ་ཐང་ཤེལ་བྲག་	༡
72	བཀའ་ཐང་གསེར་ཕྲེང་	༡
73	གསང་སྡེ་འཇིགས་གསུམ་	༡
74	བུ་སྟོན་འདུ་བའི་ལེགས་ཁྲིད་	༡
75	མངོན་བརྗོད་མཁས་པའི་རྣ་རྒྱན་	༡
76	སྙན་ངག་མེ་ལོང་མའི་འགྲེལ་ཙ་	༡
77	སྦྱོར་འཇུག་ཙ་འགྲེལ་	༡
78	དཔེ་ཆོས་རིན་ཆེན་སྤུངས་པ་	༡

ཀུན་སྡེ་གླིང་པར་ཁང་།

79	དག་ཚིག་བསྟན་པའི་མགོན་པོ་	༢
80	ཀློང་རྡོལ་རིན་པོ་ཆེ་	༢
81	དག་ཚིག་སྐུ་འཕྲེང་བཅུ་གཉིས་པ་	༡
82	ཞེ་འབུམ་འགྲེལ་པ་	༡

གཞི་སྡེ་པར་ཁང་དུ།

83	རྭ་སྒྲེང་བསྟན་པ་རབ་བརྒྱས་	༢
84	བློ་སྦྱོང་བརྒྱ་ཙ་	༡
85	ཀོང་པོ་ལམ་རིམ་	༡

བསྟན་རྒྱུས་གླིང་པར་ཁང་།

86	ཛྷམ་སེ་ཏྲི་གསུང་	༡
87	དག་པོ་བཀའ་འབུམ་	༢
88	རྗེ་བཙུན་ནམ་འགྱུར་	༡
89	གཅོད་ཚོགས་	༡

ཚེ་ཚོག་གླིང་པར་ཁང་།

90	ཡོངས་འཛིན་ཡེ་ཤེས་རྒྱལ་མཚན་གསུང་འབུམ་	༢༠
91	ལམ་རིམ་ཞི་དྲག་	༢

གནམ་འབྲུག་དགོན་པར་ཁང་།

92	འབྲུག་ཐམས་ཅད་མཁྱེན་པ་པདྨ་དཀར་པོའི་གསུང་འབུམ་	༢༠

མཚུར་ཕུའི་པར་ཁང་དུ།

93	རིན་ཆེན་གཏེར་མཛོད་	༦༠
94	རི་ཆོས་	༡
95	ཀརྨ་པའི་གསུང་སྙིང་བརྒྱུད་འབུམ་	༢
96	ཀུན་མཁྱེན་འཇིགས་མེད་གླིང་པའི་གསུང་འབུམ་	༦
97	གཅོད་དབང་བརྒྱ་རྩ་	༡
98	བཀའ་གླིང་ཞི་ཁྲོ་	༡
99	འབྲས་ལྗོངས་བླ་མ་ཨུ་རྒྱན་གྱི་སྙན་ངག་སུམ་རྟགས་	༡
100	ས་སྐྱའི་ཆོས་འཁོར་	༡

བྲག་ཡང་རྫོང་པར་ཁང་།

101	རྙིང་མ་མཛོད་བདུན་	༧
102	སྙིང་ཐིག་	༨
103	ངན་སོང་སྐོར་	༢

འོན་རྒྱལ་སྲས་ཀྱི་པར་ཁང་།

104	ཐུབ་བསྟན་འཇིགས་མེད་གསུང་འབུམ་	༢

འོད་ཀ་བླ་ལུང་པར་ཁང་།

105	བཞད་རྡོ་རྗེ་གསུང་འབུམ་	༢༨
106	རས་ཆུང་རྣམ་ཐར་	༡

ལྷོ་ཉན་དྲི་ལེགས་པར་ཁང་།

107	འབྲུག་གཙང་སྨོན་དབུས་སྨོན་	༢༨
108	མ་ངེས་ཆོས་འཁོར་	༤

རྡོར་བྲག་པར་ཁང་།

109	ཀུན་བཟང་ཞལ་ལུང་།	༡

བསྡོམས་པ་ནི་ ༣༧༢ ཡོད།

ལོ་ཆེན་དང་། པོ་ཏའི་ཤོག་གྲངས་ཀྱི་ཐོ།

ཤོག་གྲངས་ཀྱི་ཐོ།

110	བཀའ་གདམས་གླེགས་བམ་	༧·༥༥
111	ཇོ་བོ་རྗེ་གསེར་གླིང་དུ་ཕེབས་པའི་རྣམ་ཐར་	༢༢

112	ཇོ་བོའི་རྣམ་ཐར་རྒྱས་པ་	༡༠༨
113	བཀའ་གདམས་བུ་ཆོས་	༩༦༧
114	བེའུ་བུམ་སྔོན་པོའི་རྩ་འགྲེལ་	༢༤༩
115	བཀའ་གདམས་ཆོས་འབྱུང་ལས་ཆེན་རྒྱལ་བས་ མཛད་པ་	༩༡༤
116	བཀའ་གདམས་ཆོས་འབྱུང་པཎ་ཆེན་བསོད་གྲགས་ པས་མཛད་པ་	༡༠༣
117	མཁས་གྲུབ་ནོར་བཟང་རྒྱ་མཚོས་མཛད་པའི་ཕྱག་ ཆེན་གསལ་སྒྲོན་	༡༣
118	དམ་ཚིག་གསལ་སྒྲོན་	༧༡
119	དུས་འཁོར་རྣམ་བཤད་དྲི་མེད་འོད་རྒྱན་	༣༡༥
120	བཤེས་སྤྲིངས་རྩ་འགྲེལ་	༨༡
121	སློབ་སྤྲིངས་	༢༢
122	ཡར་འབྲོག་པ་རིན་ཆེན་དོག་གིས་མཛད་པའི་མན་ངག་ དབང་པོའི་རྡོ་རྗེ་དང་ཡེ་ཤེས་རྡོ་རྗེའི་ཐོག་དོག་ཆེན་པོ་	༨༣
123	སྒྲ་ཚད་པ་རིན་ཆེན་རྣམ་རྒྱལ་གྱིས་མཛད་པའི་བ་རི་བདེ་ གཤེགས་སྙིང་པོའི་མཛེས་རྒྱན་	༤༩
124	ལོ་ཆེན་ཆོས་སྐྱོང་བཟང་པོའི་སུམ་རྟགས་འགྲེལ་པ་	༡༨
125	ཀ་ལ་པའི་མདོ་	༢༤
126	དབང་ལོ་ཆེན་པོའི་ཚོགས་གསུམ་གསལ་བ་	༡༨
127	སྟག་ཚང་ལོ་ཙཱ་པའི་རིག་གནས་ཀུན་ཤེས་རྩ་འགྲེལ་	༢༢

128	གྲུབ་མཐའ་ཀུན་ཤེས་རྩ་འགྲེལ་	༡༡༨
129	ལས་ཁྲིད་གསེར་གྱི་ཡང་ཞུན་	༢༡
130	རྒྱལ་ཚབ་རིན་པོ་ཆེའི་དུས་འཁོར་རིམ་གཉིས་རྣམ་བཞག་	༤༨
131	འཁོན་སྟོན་པའི་སྐྱབས་ཁྲིད་དང་ལྷ་ཁྲིད་	༢༨
132	རྒྱལ་དབང་བདུན་པའི་དགེ་འདུན་འདུ་འཁོར་སྒྲུབ་ཚུལ་	༩
133	རྗེ་བཙུན་སྨིངས་མ་པ་ཆེན་པོ་འསོཾ་བསླབ་གསུམ་བསྟན་པའི་རྒྱལ་མཚན་གྱི་རྣམ་ཐར་སྤུགས་འཆང་དབང་ཕྱུག་རབ་བརྟན་གྱིས་མཛད་པ་	༡༨
134	ངག་དབང་ཆོས་གྲགས་ཀྱི་རྣམ་ཐར་བསོད་ནམས་རྒྱལ་མཚན་གྱིས་མཛད་པ་	༢༧
135	ཇོ་རིངས་པ་ཀུན་བཟང་ཆོས་ཀྱི་ཉི་མའི་རྣམ་ཐར་ཚར་ཆེན་བློ་གསལ་རྒྱ་མཚོས་མཛད་པ་	༨༥
136	ཡོལ་པ་རི་དཔོན་རིན་པོ་ཆེ་གཞོན་ནུ་བློ་གྲོས་ཀྱི་རྣམ་ཐར་བློ་གྲོས་རྒྱལ་མཚན་གྱིས་མཛད་པ་	༥༢
137	བོད་མཁར་མི་ཏྲི་པ་དོན་གྲུབ་རྒྱལ་མཚན་གྱི་རྣམ་ཐར་མི་ཕམ་ཆོས་ཀྱི་རྒྱལ་མཚན་གྱིས་མཛད་པ་	༧༢
138	མང་ཐོས་ཀླུ་སྒྲུབ་རྒྱ་མཚོའི་རྣམ་ཐར་རྗེ་རང་གིས་མཛད་པ་	༡༡༦
139	སྨོ་དུས་པ་ཆེན་པོ་ཀུན་དགའ་ལེགས་པའི་བློ་གྲོས་ཀྱི་རྣམ་ཐར་འཇམ་དབྱངས་མཁྱེན་བརྩེའི་དབང་ཕྱུག་གིས་མཛད་པ་	༤༠

140 བདག་ཆེན་བློ་གྲོས་རྒྱལ་མཚན་གྱིས་རྣམ་ཐར་ཚར་ཆེན་
གྱིས་མཛད་པ་ ༤༥

141 འཇམ་དབྱངས་མཁྱེན་བརྩེའི་དབང་ཕྱུག་གི་རྣམ་ཐར་རྗེ་
རང་ཉིད་ཀྱིས་མཛད་པ་ ༡༡༤

142 སྔགས་འཆང་བསོད་ནམས་ཆོས་འཕེལ་གྱི་རྣམ་ཐར་རྗེ་
རང་ཉིད་དམ་པ་གང་གི་སློབ་མ་ཧོ་རྗིའི་མིང་ཅན་གྱིས་
མཛད་པ་ ༥༢

143 པཎ་ཆེན་ཡེ་ཤེས་རྩེ་མོའི་རྣམ་ཐར་རྒྱལ་བ་དགེ་འདུན་
རྒྱ་མཚོས་མཛད་པ་ ༢༧

144 རྒྱལ་དབང་འཇམ་དཔལ་རྒྱ་མཚོའི་གསུང་འབུམ་
ཡོངས་རྫོགས་ ༢༨༠

145 ཡོངས་འཛིན་ཡེ་ཤེས་རྒྱལ་མཚན་གྱི་རྣམ་ཐར་ ༢༠༨

བསྡོམས་གྲངས་ (༦༠༨༢)

ལེ་ཚན་གྱི་ཕོ།

146 སི་ཏུ་པཎ་ཆེན་གྱི་སུམ་རྟགས་འགྲེལ་པ།

147 ཟླ་མ་ལྷག་བསམ་གྱི་སུམ་རྟགས་འགྲེལ་པ།

148 ཀརྨ་པ་གསུང་རབ་འཕྲེང་བའི་སུམ་རྟགས་འགྲེལ་པ།

149 སྡེབ་སྦྱོར་རིན་ཆེན་འབྱུང་གནས་ཀྱི་འགྲེལ་པ།

150 སློབ་དཔོན་རིན་པོ་ཆེའི་རྣམ་ཐར་ཏཱ་ར་ན་ཐས་མཛད་པ།

151 པདྨ་བཀའ་ཐང་།

152 དབུས་སྨྱོན་ཧེ་རུ་ཀའི་རྣམ་ཐར།

153 གླིང་ཡོངས་འཛིན་གྱི་འཇིགས་བྱེད་བསྐྱེད་ཆེན་སྐོར་ཡོངས་རྫོགས།

154 ཨ་མདོ་གསེར་ཁང་རྡོ་རྗེ་འཆང་གི་འཇིགས་བྱེད་བསྐྱེད་སྐོར།

155 དགའ་ལྡན་གསེར་ཁང་སྤྲུལ་སྐུའི་བདེ་མཆོག་བསྐྱེད་ཆེན་སྐོར།

156 པད་དཀར་ཞལ་ལུང་མ་བུ་ཚང་མ།

157 གཡུ་ཐོག་ཆོས་སྐོར།

158 ལམ་ཁྲིད་སྨྱུར་ལམ།

159 ཆུ་བཟང་གསུང་འབུམ་གསན་ཡིག།

160 སྤང་ལུང་གསུང་འབུམ།

161 གུང་རུ་མཁན་ཆེན་གྱི་གསུང་འབུམ།

162 སེར་གདོང་གཏེར་ཆོག་མཁའ་འགྲོའི་དགོངས་རྒྱན།

163 ཕ་བོང་ཁ་པའི་མཁའ་སྤྱོད་སྐོར།

164 འཇམ་དབྱངས་དགའ་བློའི་གསུང་སྐོར།

165 བཤེས་སྤྲིངས་ཊིཀ་རེད་མདའ་བས་མཛད་པ།

166 འཕགས་འོད་ཡོན་ཏན་རྒྱ་མཚོའི་གསང་འདུས་རྒྱུད་ཊིཀ།

167 ཉི་ཐང་དུས་ཚིགས།

168 སྐྱིད་ཚལ་མཁན་པོའི་འདུལ་བ།

169 རྒྱུད་བླ་ཐོགས་འགྲེལ།

170 ལྷ་བཙུན་དོན་གྲུབ་རྒྱལ་མཚན་གྱིས་རྗེ་རིན་པོ་ཆེའི་རྣམ་ཐར།

171 བཀའ་གདམས་གཅེས་བསྡུས།

172 ར་ལོ་ཙ་བའི་རྣམ་ཐར།

173 སྤོས་དཀར་སྤྲུལ་སྐུའི་འཇིགས་བྱེད་བསྐྱེད་རྫོགས།

174 པདྨ་བཛུརི་གདང་རྩུལ་ཆོག།

175 བ་སོ་བའི་ཧ་ཁྲིད།

176 རྡོ་རྗེ་ཤུགས་ལྡན་གྱི་གསོལ་མཆོད།

177 དྭགས་པོ་ དགེ་བ་ཤེས་ བློ་བཟང་ སྦྱིན་པའི་ བློས་ བླངས་དཀར་ཆག།

178 ལྷ་སའི་དཀར་ཆག།

179 སེར་འབྲས་དགེ་གསུམ་ བཀྲས་ ལྷུན་རྒྱུད་ གྲྭ་ གཉིས་བཅས་ཀྱི་ དཀར་ཆག།

180 ཕོ་བྲང་པར་ཐོ།

181 ཐོ་ཡོན་བླ་མ་རིན་པོ་ཆེ་དང་འཇམ་དབྱངས་འཕྲིན་ལས་གཉིས་ཀྱི་གསུང་སྐོར།

182 འཇམ་དབྱངས་དགའ་བློ་འི་ལྷ་ཁྲིད་རྒྱས་འབྲིང་གཉིས།

183 སྒུར་ལམ་སྨོན་འགྲོ་འི་སྦྱོར་བའི་ཆོས་དྲུག།

184 ལྷོ་ རྒྱུད་སྨོན་འགྲོ་འི་སྦྱོར་བའི་ཆོས་དྲུག།

185 མགོན་པོ་འི་གཏོར་ཆེན་དང་གཏོར་སྒྲུབ།

186 འཇིགས་བྱེད་དྲག་པོ་འི་སྦྱིན་བསྲེག་རྣམས་སྟོད་རྒྱུད་ལུགས།

187 དམ་ཆོས་ཚང་གི་རྟེན་འབྲེལ་བསྟོད་འགྲེལ།

188 ཁྲི་ཀན་ཚང་གི་བསྡུས་ཀྭ།

189 ཡོངས་འཛིན་ཡེ་ཤེས་རྒྱལ་མཚན་གྱི་གསན་ཡིག།

190 ལྟུང་བཤགས་ཊཱིཀ།

191 གྲུབ་མཆོག་བློ་བཟང་རྣམ་རྒྱལ་གྱི་གཅོད་གཞུང་།

192 ཐང་སག་པའི་འཛིགས་བྱེད་བསྐྱེད་རྫོགས།

193 བྱམས་པ་ཡོན་དན་གྱི་བདེ་ལམ་ཟིན་བྲིས།

194 སྨེ་སྲིད་བསྡུས་གྲྭ།

195 བྲག་ཡབ་བློ་བཟང་བསྟན་པའི་བསེ་ཁྲབ་གསོལ་མཆོད།

196 སྙན་གྲགས་དགེ་བཤེས་ཀྱི་ས་ལམ་མཉམ་བཞག།

197 བྲ་སྟིའི་ཕར་ཕྱིན་དྲིས་ལན།

198 ཀུན་གཞིའི་དྲིས་ལན།

199 ལྷ་སྨིངས་རྒྱལ་སྲས་པའི་དྭགས་པོ་ཆོས་འབྱུང་ཁ་སྐོང་།

200 དབྱངས་འཆར་ལག་ལེན་འོད་ཟེར་བརྒྱ་པའམ་ནོར་བུའི་ཕྲེང་
བ་དྲུང་བ་རྡོ་རྗེ་དང་སྨེ་སྲིད་པའི་མཚན་དང་བཅས་པ།

201 དབངས་ལོ་ཆེན་པོ་འི་བརྡའ་སྤྲོད་སྙིང་པོ་རང་འགྲེལ་བཅས།

202 སྨེ་སྲིད་པའི་མཚམས་སྦྱོར་ལྔ་པའི་འགྲེལ་པ།

203 འདར་ལོ་ཙཱ་བའི་དབྱངས་ཅན་སྒྲ་ཊཱིཀ།

204 སྒྲ་པཱ་ཎི་པ་ཙ་འགྲེལ།

205 བློ་སྦྱོང་བརྒྱ་རྩ།

206 འཁོན་སྟོན་རྡོང་བཀའ་འགྲེལ།

207 སྐོས་སྨེའི་དབུ་མ་གསར་སྙིང་།

208 ནམ་མཁའ་བསྟན་སྐྱོང་གི་སྦྱོར་ཆོས་རྩ་འགྲེལ།

209 རིགས་བརྒྱ་སྤྲུལ་སྐུའི་སྲི་མནན་ཆོག།

210 རྗེ་དགེ་འདུན་གྲུབ་པའི་གསུང་འབུམ།
211 དགེ་འདུན་རྒྱ་མཚོའི་གསུང་འབུམ།
212 བསྐལ་བཟང་རྒྱ་མཚོའི་གསུང་འབུམ།
213 འཇམ་དབྱངས་སྨོན་ལམ་གྱི་གསུང་འབུམ།
214 ལྕང་སྐྱ་གོང་མའི་གསུང་འབུམ།
215 རྭ་སྒྲེང་བསྟན་པ་རབ་རྒྱས་ཀྱི་གསུང་འབུམ།
216 ཁང་གསར་སྤྲུལ་སྐུའི་གསུང་འབུམ།
217 ལྷ་པ་ཆེན་པོའི་གསུང་འབུམ།
218 ལོ་ཙཱ་བ་བློ་ལྡན་ཤེས་རབ་ཀྱི་རྒྱུད་བླའི་བསྡུས་དོན།
219 སྤོས་དཀར་སྤྲུལ་སྐུའི་མ་མོའི་འབྲུག་སྐོང་།

V. INDEX TO TITLES.

WITH TRANSLATION AND NOTES.

1. ཀར་གླིང་ཞི་ཁྲོ་ (98). (Concerning the) peaceful and fearful (aspects of the gods) by (the revealer) Karmalingpa (ཀར་མ་གླིང་པ་) སྒྲུ་རིམ་, ritual. བཀའ་རྒྱུད་, Kagyü.

2. ཀརྨ་པ་གསུང་རབ་འཕྲེང་བའི་སུམ་རྟགས་འགྲེལ་པ་ (148). Commentary on the grammar in the garland of the collected works of the Karmapa lama.

བཀའ་རྒྱུད་བླ་མའི་གསུང་སུམ་རྟགས་ the grammar of a Kagyü lama as orally taught by him

3. ཀརྨ་པའི་གསུང་སྙིང་བརྒྱུད་འབུམ་ (95). The oral teaching of the Karmapa (Lama) concerning the hundred thousand (= collected doctrines) of the old tradition. Kagyü.

4. ཀཱ་ལཱ་པའི་མདོ་ (126). Kālāpa sūtra, probably the same कलापसूत्र as in Tanjur, mdo. Vol. ལེ, 116, No. 9. Schiefner fol. 86 Cordier fol. 91. Immediately followed in the Tanjur by two commentaries, with another three कलाप treatises in mdo. Vol. ནོ (132).

Explained as སྒྲ་ཡི་དཔེ་ཆ་, a book about words, i.e on the translation from Sanskrit in Tibetan, particularly: dictionary. See No. 61 below.

5. ཀུན་མཁྱེན་འཇིགས་མེད་གླིང་པའི་གསུང་འབུམ་ (96). Collected works of the all-knowing Jikmelingpa. One of the eight གཏེར་བཏོན་ or revealers of hidden scriptures. རྣམ་ཐར་ or biography. The author is said to belong Khams. རྫོགས་ཆེན་, dzokchen sect.

6. ཀུན་བཟང་ཞལ་ལུང་ (109). Precepts of Lama Kunzang (from Khams), dzokchen.

7. ཀུན་གཞིའི་དྲིས་ལན་ (198). Answers to questions concerning the soul ?

8. ཀེ་ཚང་འཇམ་དབྱངས་གསུང་ (53). The oral teachings of (Lama) Jamyang (Mañjughoṣa) from (the monastery or hermitage of) Ketshang.

9. ཀོང་པོ་ལམ་རིམ་ (86). The gradual way of (the country of) Kongpo. (S.E. Tibet.) Probably a manual of meditation, and one of the many Lamrims distinguished by the name of the country in which they have originated. See No. 198.

10. ཀླུ་འབུམ་དཀར་ནག་ཁྲ་གསུམ་ (61). The three Nāga hundred thousands, white, grey and black. Bon-po. There are three series of works under this name, which have for the greater part no mutual connection. The smallest collection, exceedingly frequent, has been published by Laufer in the Memoirs of the Finnish Society in Helsingfors. (In the first he has skipped a leaf of the text.) Two of the three parts of this little work are based on a larger work called ཀླུའི་སྤྱང་བསྐོང་ (with variations in spelling), which is included in most domangs. The middle series occurs in many domangs, but only the 'white' part in most of them. The two other parts are usually contained in Bhutanese domangs. The larger edition is printed separately in three volumes, and I recently acquired an excellent print from new blocks, from Lhasa. It is said that good Derge prints of this class of works are much valued. Schiefner has translated the middle-size 'white' Lubum. (Since writing the above I have also acquired a Derge print of the larger edition.)

11. ཀློང་རྡོལ་རིན་པོ་ཆེའི་སྨོན་ལམ་ (80). The prayer of the precious Lama Longdöl, Overflowing Wave. Thomas (No. 10, from Peking, No. 311^{b}) quotes a ཀློང་རྡོལ་ བླ་མ་ ངག་ དབང་ བློ་བཟང་གི་གསུང་འབུམ་.

12. བཀའ་འགྲེལ་ (33). Commentary on the word, or the commands. No details.

13. བཀའ་ཐང་སྡེ་ལྔ་ (70). The well-known "Five Chapters of plain words." One of them published and translated by Laufer. "Plain words," literary as well as metaphorically, according to an oral explanation of thang as plain. See No. 14, 15, 127.

14. བཀའ་ཐང་ཤེལ་བྲག་ (71). Crystal rock of plain words. Ascribed to Padmasaṃbhava. Nyingmapa. See above.

15. བཀའ་ཐང་གསེར་ཕྲེང་ (72). The golden rosary of plain words. Ascribed as above. Nyingmapa.

16. བཀའ་གདམས་པ་གླེགས་བམ་ (110). "Kadampa Volume," no details. Evidently an essential or typical manual. Note: ཞལ་གདམས་, oral teaching.

17. བཀའ་གདམས་གཅེས་བསྡུས་ (171). The beloved or precious Kadampa abstract or summary. "Oral teaching," ཞལ་གདམས་.

18. བཀའ་ གདམས་ ཆོས་ འབྱུང་ པཎ་ ཆེན་བསོད་ གྲགས་ པས་ མཛད་པ་ (116). The history of the origin (and growth) of the Kadampa sect, written by the great Pandit Sötak, Virtue-fame ཞལ་གདམས, oral teaching Gelukpa sect.

19. བཀའ་ གདམས་ཆོས་ འབྱུང་ལས་ཆེན་ རྒྱལ་ བས་ མཛད་པ་ (115). History of the origin (and growth) of the Kadampa sect, written by Lächengyalwa Illustrious Great-Work. 'Oral teaching.'

20. བཀའ་གདམས་ཕ་ཆོས་བུ་ཆོས་ (18). The doctrines of the Kadampa father and son, i.e of Atisha and Domtön, ཨ་ཏི་ཤ་ and འབྲོམ་སྟོན་. See below

21. བཀའ་གདམས་བུ་ཆོས་ (113).' The doctrines of the Kadampa son, Domtön. See above. 'Oral teaching.'

22. བཀའ་གདམས་གསུང་ཐོར་བུ་ (40). Smaller Kadampa works. So the oral explanation: ཐོར་བུ་ = small.

23. བཀའ་པོད་ལྔའི་འགྲེལ་པ་ (26). Commentary on the five volumes of the word ? པོད=པོ་ཏི་, volume

24. སྐྱིད་ཚལ་མཁན་པོའི་འདུལ་བ་ (168). Vināya of the abbot (or professor) of Kyitshal (Happy-grove, monastery).

25. བསྐལ་བཟང་རྒྱ་མཚོའི་གསུང་འབུམ་ (213). Collected works of the seventh Dalai Lama, Kalzang Gyatsho. Also called སྐྱབས་མགོན་བསྐལ་བཟང་. Kyabgön is the popular Tibetan title for the Dalai and Teshu Lamas, as well as for other great Lamas. See below No 49.

26. ཁ་ཐོ་བཟོད་པ་རྒྱ་མཚོའི་གསུང་ (55). The works of Lama Zöpagyatsho of Khatho Khatho is a monastery a day North of Lhasa གསུང་ as in Nos. 67 and 112.

27. ཁང་གསར་སྤྲུལ་སྐུའི་གསུང་འབུམ་ (216). The collected works of the Kangsar tülku (the Incarnation of the New House, a place in Sikhim)

28. ཁྲི་རྙིན་ཚང་གི་བསླུས་གྲྭ་ (188) Explained as the " easy introduction " of the college(or house) of the old pulpit (or seat) No further details མཚན་ཉིད་དཔེ་ཆ་, philosophy. Gelukpa.

29. ཁྲི་ཆེན་གསུང་འབུམ་ (37). Collected works from the great pulpit (of Galdan, Lhasa). Namthar. Gelukpa. ཁྲི=ཁྲི་རིན་པོ་ཆེ་.

30. ཁྲི་རིམ་བྱོན་གསུང་འབུམ་ (50). Collected works, set forth in order, from the pulpit (of Galdan, Lhasa). Namthar. Gelukpa.

(59.) ཁྲི་གདམ་པ་, etc., see སྒོ་དམ་པ་, etc., below.

31. མཁས་གྲུབ་ནོར་བཟང་རྒྱ་མཚོས་མཛད་པའི་ཕྱག་ཆེན་གསལ་སྒྲོན་ (117). The illuminating lamp Mahāmudrā, written

by Khedubnorzanggyatsho. (Not a Dalai Lama.) Classed as སེམས་ཁྲིད་, soul-guide.

32. འཁོན་སྟོན་རྡོང་བཀའ་འགྲེལ་ (206). Commentary on the teachings of the Ṛshi (རྡོང་=དྲང་སྲོང་) Teacher of the Khön (family).

33. འཁོན་སྟོན་པའི་སྐྱབས་ཁྲིད་དང་ལྷ་ཁྲིད་ (131). Guide to the finding of the refuge and the (Tutelary) God, by the Teacher of the Khön (family).

34. གུང་རུ་མཁན་ཆེན་གྱི་གསུང་འབུམ་ (161). Collected works of the great abbot (or professor) of (the) Gungru (monastery ?). Namthar.

35. གྲངས་ངེས་ཞི་འགྲེལ་ (32). Commentary on the peace of the true number(s). མཚན་ཉིད་, philosophy.

36. གྲངས་ངེས་ཐལ་སྦྱོར་ (4) The method to arrive at the true number(s). མཚན་ཉིད་, philosophy. Gelukpa.

37. གྲུབ་མཆོག་བློ་བཟང་རྣམ་རྒྱལ་གྱི་གཅོད་གཞུང་ (191). The quintessential text (གཞུང་) on the Chö philosophy, by Lama Dubchoklozang namgyal. གཅོད་, a tantrik doctrine, also a class of books dealing with it. See No. 75. Also Walsh's list, No. 34 series *a* to *l*. In གཅོད་ rituals the fife, bell and damaru but not cymbals or drum are used. That is: རྐང་གླིང་ དྲིལ་བུ་ and ཌ་མ་རུ་ but not རོལ་མོ་ and རྔ་.

38. གྲུབ་མཐའ་ཀུན་ཤེས་རྩ་འགྲེལ་ (128). Commentary and text of the Dubtha Künshe, the Siddhānta leading to omniscience.

39. གྲུབ་མཐའ་ཆེན་མོ་ (29). The great book on Siddhānta. མཚན་ཉིད་, philosophy. Gelukpa. See 73, 102.

40. གླིང་ཡོངས་འཛིན་གྱི་འཇིགས་བྱེད་བསྙེན་ཆེན་སྐོར་ཡོངས་རྫོགས་ (153). Complete exposition concerning the great propitiation of the God Jikche, Fear-maker (Yamāntaka), by the Yongdzin of Ling. Yongdzin, the title of the teachers of high Lamas such as the Dalai Lama, meaning the same as དགེ་རྒན་. Ling, the house of the author, this special Yongdzin, teacher of one of the Dalai Lamas, in Lhasa. Gelukpa. See No. 183

41. དགའ་ལྡན་གསེར་ཁང་སྤྲུལ་སྐུའི་བདེ་མཆོག་བསྙེན་སྐོར་ (155). Concerning the propitiation of Demchok (Saṃvara) by the Incarnation from the Golden House The Golden House is a small house in the Galdan monastery in Lhasa, presided over by an Incarnation.

42. དགེ་འདུན་རྒྱ་མཚོའི་གསུང་འབུམ་ (15). Complete works of Gendün Gyatsho, the second Dalai Lama. Gelukpa. Nam thar.

43. id. གསུང་འབུམ་ (211), is the same work as above.

44. དགོངས་པ་ཟངས་ཐལ་ (46). Unhindered straight arrival at meditation. No details.

45. མགོན་པོའི་གཏོར་ཆེན་དང་གཏོར་སྒྲུབ་ (18). The great strewing offering to Mahākāla and the offering rituals. སྒྲུབ་རིམ་, ritual. (Sādhana, niyama.)

46. མགོ་པོའི་ཞལ་ལུང་ (66). The oral teachings of Gopo. No details. Not likely a mistake for མགོན་པོ, Mahākāla, in connection with whom the expression ཞལ་ལུང་ would hardly fit.

47. མགྲིན་སྔོན་ཟླ་བའི་རྟོགས་བརྗོད་ (42). The avadāna of Blue-throat-moon, Nīla-kaṇṭha-candra-avadāna.

This is evidently the same as Schiefner's (Bericht, No. 431); བྱང་ཆུབ་ཀྱི་སེམས་མངའ་བའི་བྱ་མགྲིན་སྔོན་ཟླ་བའི་རྟོགས་པ་བརྗོད་པ་འཁོར་བ་མཐའ་དག་སྙིང་པོ་མེད་པར་མཐོང་བ་རྣམས་ཀྱི་རྣ་རྒྱན་ཞེས་

བྱ་བ་, avadāna of the blue-throat Bird, Moon, with perfect enlightenment, called the ear-ornament of those realising the world to be without end or essence, 144 leaves. This and other coincidences between our lists and those of Schmidt and Schiefner, show that the taste in reading in Tibet has not changed so much in the 75 years which separate the first from the last. From a description of the contents told to me by a Tibetan friend who had read the book ' very long ago ' it would appear as if this is a story based on or identical with the Śibi Jātaka.

In the Kanjur (Beckh), mdo, Vol. ཨ༢ (32), there is a Candraprabhāvadāna, ཟླ་འོད་ཀྱི་རྟོགས་པ་བརྗོད་པ་. I do not know whether this story is related to the one mentioned above. The question may be settled early, as, by a happy accident, I found, after this paper was written, an (uncatalogued) copy of this work in the collection of the Asiatic Society of Bengal

48. རྒྱ་གར་ཆོས་འབྱུང་ (24). Rise of the (Buddhist) religion in India.

Sarat Chandra Das, in his dictionary, gives ཆོས་འབྱུང་ as a class of works. Dr. Thomas mentions four works of this class. One by Tārānātha, edited by Schiefner, one by Buston (Wassiliew, p. 361), and two without author's name. (Peking, No. 286^{b} and Csoma de Körös, p. 148) It is interesting to know that in Tibet ཆོས་འབྱུང་ works are still current enough to be included in the present lists.

49. རྒྱལ་བ་བསྐལ་བཟང་རྒྱ་མཚོའི་གསུང་འབུམ་ (13). The same as No. 25 here. Namthar. Gelukpa.

50. རྒྱལ་བ་དགེ་འདུན་གྲུབ་གསུང་འབུམ་ (14). The works of Gendündub. The first Dalai Lama, not the second, above No. 42. Of a one volume Tashilhunpo edition, clearly printed, there are now three copies in Calcutta. One in the Imperial Library, one in the University Library, and one in my private collection. See No. 80.

51. རྒྱལ་བ་ལྔ་པའི་གསུང་འབུམ་ (12). The works of the fifth Dalai Lama, i.e. Ngakwanglozanggyatsho, ངག་དབང་བློ་བཟང་རྒྱ་མཚོ་ Though this head of the Church presided

over the Gelukpas, his works are, curiously, classed as རྙིང་མ་ nyingma, by my informants, as it is held that he turned Nyingmapa later in life. Namthar. See No. 70.

52. རྒྱལ་བ་རིམ་བྱོན་རྣམ་ཐར་ (19). History of the successive Dalai Lamas. Gelukpa. Namthar.

53. རྒྱལ་དབང་འཇམ་དཔལ་རྒྱ་མཚོའི་གསུང་འབུམ་ཡོངས་རྫོགས་ (144). Perfect, complete works of Gyalwang jampal gyatsho, the seventh Dalai Lama. Geluk. See next number.

54. རྒྱལ་དབང་བདུན་པའི་དགེ་འདུན་འདུ་འཁོར་སྒྲུབ་ཚུལ་ (132). Rituals for the meeting of the Clergy, by the seventh Dalai Lama. See previous number. Geluk. A note gives the title རྒྱལ་བ་སྐུ་ཐོག་བདུན་པ་, in which སྐུ་ཐོག་ has the meaning of "incarnation," a "life" or "appearance on earth"

55. རྒྱལ་ཚབ་རིན་པོ་ཆེའི་དུས་འཁོར་རིམ་གཉིས་རྣམ་བཞག་ (130). Methodical arrangement of the two ways of the Kālacakra, by the Precious Vice-Roy (Gyaltshab).

56. རྒྱུད་བླ་ཐོགས་འགྲེལ་ (169). Commentary on the obstructions of the Tantrik Lamas? (Very doubtful, but so according to oral information.)

57. རྒྱུད་བཞི་ (62). The four tantras. སྨན་གྱི་དཔེ་ཆ, medical book. See H Laufer and Csoma de Körös on medical literature. Schiefner has a long title (486–488) as follows: གསོ་བ་རིག་པའི་བསྟན་བཅོས་སྨན་བླའི་དགོངས་རྒྱན་རྒྱུད་བཞིའི་གསལ་བྱེད་བི་དུ་རྱ་སྔོན་པོའི་མལླི་ཀ. See below. Waddell (No. 441) has another work called "Four Tantras," but in the title he gives, the numeral four does not occur. See No. 152.

58. རྒྱུད་བཞིའི་འགྲེལ་པ་ (65). Commentary on the four tantras. Medical. See above. Cf. Waddell's Nos. 446, 447, and here No. 151.

59. སྒོ་དུས་ (=ཁྲོ་གདུས་) པ་ཆེན་པོ་ཀུན་དགའ་ལེགས་པའི་བློ་

གྲོས་ཀྱི་ རྣམ་ ཐར་ འཇམ་དབྱངས་མཁྱེན་བརྩེའི་དབང་ཕྱུག་གིས་མཛད་པ་ (139). The story of the great (Lama) Furious, All-pleasing, Good, Clever-mind, written by (Lama) Wise and Loving Lord Mañjughoṣa Kagyüpa Namthar. (Mystically the ritualist becomes one with his God during his rites, and what he writes, says or does is done by that God. An 'in the name of' or 'inspired by' is not required from this point of view.) See No. 87.

60. སྒོམ་སྡེའི་དབུ་མ་གསར་རྙིང་ (207). Old and new middle divisions of meditation ? (A Mādhyamika treatise ?).

61. སྒྲ་ཀ་ལ་པའི་སུམ་རྟགས་ (25). The grammatical treatise Kalāpa See No 4 above.

62. སྒྲ་པ་ཎི་ (68). Said to be a treatise on translation (from Sanskrit into Tibetan). Is Pāṇini hidden behind this title ? The Tibetan Pāṇini material is contained in the Tanjur, mdo. vols. ཙེ་ (134), ཚེ་ (135) and ཛེ་ (136). See next number.

63. སྒྲ་པ་ཎི་པ་རྩ་འགྲེལ་ (204). The same, text and commentary. See previous number.

64. སྒྲ་ ཚད་ པ་ རིན་ ཆེན་ རྣམ་ རྒྱལ་ གྱིས་ མཛད་ པའི་བ་རེ་བདེ་གཤེགས་སྙིང་པའི་མཛེས་རྒྱན་ (123). (The book called) the beautiful ornament of (the work named) the essence of the Sugata, of the Bare monastery, written by Datshäpa-rincennamgyal. (Ba-re is said to be the name of a monastery in Lhasa.)

It seems to me that སྒྲ་ཚད་པ་ might be a title: debater, logician, but my informants think it is the name of a monastery.

65. ངག་དབང་ཆོས་གྲགས་ཀྱི་རྣམ་ཐར་བསོད་ནམས་རྒྱལ་མཚན་གྱིས་མཛད་པ་ (134). The story of (Lama) Ngakwangchötak, written by Sönamgyaltshan. Namthar.

66. ངག་དབང་ཆོས་རྗེའི་མཛོད་གནས་པོད་ (51). The book (called) the Treasury of the master of the Dharma, Ngakwang. པོད་=པོ་ཏི.

67. ངག་དབང་བྱམས་པའི་གསུང་ (54). The works of Ngakwang Jampa. Namthar. Said to have been the teacher of the present Dalai Lama, and to have died some 20 years ago at an advanced age. གསུང་ as in 26 and 112, 'words spoken by.'

68. ངན་སོང་སྐོར་ (103). About going to perdition.

69. མངོན་བརྗོད་མཁས་པའི་རྣ་རྒྱན་ (75) Ear-ornament of the experts in the use of synonyms. མངོན་བརྗོད་, synonomy, abhidhāna

The abhidhāna literature in Tibet is very rich, but still little explored S. C. D., in his Dictionary, list of authorities, quotes a work with the above title, which he has excerpted in his dictionary, though, unhappily, not distributing the articles alphabetically, but lumping them together in the Tibetan (and Indian) way under the synonymic key word. Desgodins has also used similar works, without distributing the material alphabetically, in his Dictionary. I possess a MS. copy of what is probably this same work though the title given in the MS. reads མངོན་བརྗོད་ཀྱི་བསྟན་བཅོས་མཁས་པའི་རྣ་རྒྱན་ A smaller treatise of a similar nature is the མངོན་བརྗོད་ཀྱི་བསྟན་བཅོས་རྒྱ་མཚོའི་ཆུ་ཐིགས་, of which I have a printed as well as a MS. copy. It is certain that the next Tibetan dictionary will have to digest this class of works more systematically, and it is probable that even Sanskrit lexicography will derive some benefit from their complete analysis

70. ལྔ་པ་ཆེན་པོའི་གསུང་འབུམ་ (217) The collected works of the fifth Dalai Lama This according to the gloss: རྒྱལ་བ་ལྔ་པའི་རྣམ་ཐར་, that is ངག་དབང་བློ་བཟང་རྒྱ་མཚོ་ We have already had this work under No 51. Probably different from the Ngakwangs under Nos. 65–67.

71. སྔགས་འཆང་བསོད་ནམས་ཆོས་འཕེལ་གྱི་རྣམ་ཐར་རྗེ་རང་ཉིད་དམ་པ་གང་གི་སློབ་མ་རྡོ་རྗེའི་མིང་ཅན་གྱིས་མཛད་པ་ (142). The biography of Lama Ngakchang chöphel, written by His Holiness' pupil named Dorje (Vajra).

72. ལྕང་སྐྱ་གོང་མའི་གསུང་འབུམ་ (214). Collected works of the (Mongolian = སོག་པོ) Cangkya Gongma Lama. See S. C. D., Dictionary, under both ལྕང་སྐྱ་ and གོང་མ་, and also Grünwedel, Mythologie. According to the data in Das, the above translation is open to doubt, though my informants think that གོང་མ་ is here so much as 'Imperial,' an adjective of rank, derived from the designation of the Emperor of China.

73. ལྕང་སྐྱ་གྲུབ་ཐ་ (=མཐའ་). (52). Siddhānta by the Cangkya Lama. Philosophy ? See Nos. 38, 39, 102.

74. ལྕང་སྐྱ་ངག་དབང་ཆོས་ལྡན་ (16). (Works or biography ? of) the Cangkya Lama Ngakwang Chödan.

75. གཅོད་དབང་བརྒྱ་རྩ་ (97). The hundred (chapters, topics ?) on the powers of chö tantrism. See No. 37. སྒྲུ་རིམ་, ritual. Kagyü. See also next number.

76. གཅོད་ཚོགས་ (89). Various points on chö tantrism. སྒྲུ་རིམ་, ritual. Kagyü ཚོགས་=སྣ་ཚོགས་ Perhaps identical with Walsh, No. 34, series *a*, or with the whole collection under that number

77. ཆུ་བཟང་གསུང་འབུམ་ (48). Collected works from the Cuzang monastery (not far North of Lhasa) Namthar. Geluk In Tibet there are many collections only named after the monastery in which they are produced. They contain the works of the successive authors resident in such a place, and form a record of the literary activity of the institution throughout its existence, growing as long as the intellectual life there continues to be productive. These series are printed from uniform blocks, and as long as they are added to, kept open or running. When there is enough matter to make up a volume it is usually marked with a serial letter in the margin, the various constituent chapters or treatises are definitely arranged, and an index to the volume is added. The uncompleted volume in course of preparation usually has a black square in the margin on which only after completion of the volume the serial letter is cut out and, as long as incomplete, has no index. So

I possess a collection of about ten completed volumes of such a series whilst the eleventh bundle represents the matter of only half a volume and is still in course of publication. This is all what was printed off last year when I acquired it from the monastery press. This year another chapter may have been added to it, and so it will go on till that particular monastery ceases to be productive. See below.

78. ཆུ་བཟང་གསུང་འབུམ་གསན་ཡིག་ (159). List of oral teachings from the Cuzang monastery. (So the oral explanation.) Namthar. Geluk. Whether the same as the above. or part of it, seems uncertain. གསན་ཡིག་, list, conspectus, plan, programme, summary, table, catalogue raisonné, etc., in the sense of record of teachings orally received from any lama: diary or notes of teachings received. See No 211.

79. ཆོས་ཆེན་བཅོ་བརྒྱད་ (35). The eighteen chapters of the Dharma.

80. ཇོ་བོ་རྗེ་གསེར་གླིང་དུ་ཕེབས་པའི་རྣམ་ཐར་ (111). The story of Atisha's arrival in Serling. Geluk. Serling according to S. C. D. Suvarṇadvîpa. Pegu.

Schiefner, Bericht 286ᶜ: ཇོ་བོ་རྗེ་ལྷ་གཅིག་དཔལ་ལྡན་ཨ་ཏི་ཤས་རྒྱ་གར་དུ་བསྟན་པ་རྗེ་ལྟར་སྤེལ་བ་དང་གསེར་གླིང་ལ་ཕེབས་པ་སོགས་ཀྱི་རྣམ་ཐར་ Story of how the noble Illustrious Lord Atisha (the incarnation of) the Unique God, has spread the teaching in India, and has come to the Gold-land. and so on. 23 leaves. Tibetan print.

81. ཇོ་བོའི་རྣམ་ཐར་རྒྱས་པ་ (112). The fuller biography of Atisha.

82. འཇམ་དབྱངས་མཁྱེན་བརྩེའི་དབང་ཕྱུག་གི་རྣམ་ཐར་རྗེ་རང་ཉིད་ཀྱིས་མཛད་པ་ (141). The biography or works of the Wise, Loving Lord Mañjughoṣa, by himself. See No. 59.

83. འཇམ་དབྱངས་དགའ་བློའི་ལྷ་ཁྲིད་རྒྱས་འབྲིང་གཉིས་ (182). The two recensions, full and medium, of (the work) conducting towards God Mañjughoṣa, by (Lama) Galo (Joymind?),

uncertain, see S. C. D., s.v. ཀླ་ལོ་, but see next number. There is also a ཀླུ་ལོ་ཙྪ་ (པ་). See Laufer's Klu hbum, p. 18–19).

84. འཇམ་དབྱངས་དགའ་བློའི་གསུང་སྒོར་ (164). About the writings of Galo concerning Mañjughoṣa. Uncertain. See previous number. Namthar.

85. འཇམ་དབྱངས་སྨོན་ལམ་གྱི་གསུང་འབུམ་ (213). Collected works of Lama Mañjughoṣa-prayer. (The first four syllables taken as a name.) Namthar.

86. འཇིགས་བྱེད་དྲག་པོའི་སྦྱིན་སྲེག་རྣམས་སྟོད་རྒྱུད་ལུགས་ (186). (Mantra) method of the tantrik Upper Monastery in the matter of burnt-offerings to the fierce Jikche. (སྟོད་ here upper, against སྨད་ lower.) Kurim, ritual

87. རྗེ་དགེ་འདུན་གྲུབ་པའི་གསུང་འབུམ་ (210). The works of Gendündub The same as No. 50.

88. རྗེ་རྣམ་ཐར་ (28). The story or works of some རྗེ་, Ārya, whose name is not given. In our list the title does not appear near that of any special རྗེ་ The book is printed in a Däpung press, so it might be that the Je in question is Tsongkhapa, but no reliable conclusion can be drawn. The proximity to No. 87 here is only accidental, arising out of the alphabetical arrangement, so that this Je may as well as not be Gendündub.

89. རྗེ་བཙུན་འདིང་མ་པའི་རྣམ་ཐར་ (20). The story or works of Jetsün Dingmapa. In the next entry སྡིངས་ is written instead of འདིང་ In this orthography the word seems to be a geographical name.

90. རྗེ་བཙུན་སྡིངས་མ་པ་ཆེན་པོའམ་བསླབ་གསུམ་བསྟན་པའི་རྒྱལ་མཚན་གྱི་རྣམ་ཐར་ཐུགས་འཆང་དབང་ཕྱུག་རབ་བརྟན་གྱིས་

མཛོད་པ་ (123). Biography of the Great Jetsün Dingmapa, or the Royal Banner explaining the three teachings, written by Ngakchang Wangchukrabtan (The true Lord Mantradhara). See No. 89.

91. རྗེ་བཙུན་རྣམ་འགུར་ (88). The namthar and songs of Milaräpa. རྗེ་བཙུན་ alone is often Milaräpa, like རྗེ་བོ་ alone is Atisha. རྗེ་བོ་རྗེ་ is exclusively Atisha. The two collections of this poet are sufficiently well-known, and have been often dealt with by European scholars. Note the abbreviation for namthar plus gurbum. See No. 180.

92. ཉི་ཐང་དུས་ཚོགས་ (167). Discourse (ཚོགས་) on the occasion (དུས་) of the exhibition of the scroll (or banner, ཐང་ཀ་) on the Sundays. Refers to a custom in both Lhasa and Tashilhünpo to exhibit newly painted thankas on Sundays, to the Dalai and Tashi Lamas.

93. རྙིང་མ་མཛོད་བདུན་ (101). The seven treasures (or treasuries) of the Nyingmapas. Nyingma.

94. སྙན་གྲགས་དགེ་བཤེས་ཀྱི་ས་ལམ་མཉམ་བཞག་ (198). Arrangement of places and ways by Geshe Nyäntak. (A dice game, which, by means of a board and dice, shows the destiny of the players, whether and how they will arrive in hell or heaven, etc.) མཉམ་བཞག་=རྣམ་བཞག་ Described as སྒོམ་གྱི་དཔེ་ཆ, meditation book. Geluk.

95. སྙན་ངག་མེ་ལོང་མའི་འགྲེལ་རྩ་ (76). Text and commentary of the Kāvyādarṣa (by Daṇḍin). སྙན་ངག་, poetry There is an appreciable Tibetan literature on the Kāvyādarṣa, and there are not only various commentaries on the work, and works giving poetical examples (དཔེར་བརྗོད་) to illustrate it, but there are other translations of the text than the one in Vol. mdo ཞེ་, 117, of the Tanjur. I possess some of these.

Again, Derge is reputed to have produced some important works of the kind.

96. སྙིང་ཐིག་ (102). Heart-drop. A class of different works referring to the Dzokchen sect. The term means as much as 'pearl' in its metaphorical sense, the precious 'heart' or 'kernel' of teachings, 'pearls of wisdom.'

97. *Id.* (44).

98. སྟག་ཚག་སྐུ་འཕྲེང་བཅུ་གཉིས་པ་ (81). The string of twelve incarnations of the Taktshak presence. (A Lhasa incarnation in Däpung.) See next. Gelukpa.

99. སྟག་ཚག་བསྟན་པའི་མགོན་པོ་ (79). The Taktshak master of the teaching. See previous number

100. ལྟུང་བ་ཤགས་ཊིཀ་ (190). Commentary on (the book on) the confession of sin (or lapses). སྨོན་ལམ་, prayer.

101. སྟག་ཚང་ལོ་ཙཱ་བའི་ རིག་གནས་ཀུན་ཤེས་རྩ་འགྲེལ་ (127). Text and commentary of the "Omniscience" of Taktshang Lotsava. Taktshang a place in Tibet, the birth-place of the Lotsava.

102. ཐ་སྐྱབ་ (45). Unexplained. See Nos. 38, 39, 73.

103. ཐང་སག་པའི་འཇིགས་བྱེད་བསྐྱེད་རྫོགས་ (192). Development of the meditation on Yamāntaka (Jikche) according to the method of the (monastery of) Thangsak. (S. C. D. Dict., name of a district in Phanyul, W.N.W of Lhasa.) སྒོམ་རིམ་, manual of meditation. Geluk.

104. ཐུབ་བསྟན་འཇིགས་མེད་གསུང་འབུམ་ (104). Works of Thubtanjikme. Namthar.

105. ཐོ་ཡོན་བླ་མ་རིན་པོ་ཆེ་དང་འཇམ་དབྱངས་འཕྲིན་ལས་གཉིས་ཀྱི་གསུང་སྒྲོར་ (181). Concerning the utterances of both the Precious Lama of Thoyön and Mañjughosa-karma. (The second group of syllables treated as a name.) Namthar.

106. དམ་ཆོས་ཚང་གི་རྟེན་འབྲེལ་བསྟོད་འགྲེལ་ (187). Hymn, with commentary, on the Nidānas, from the holy house of religion.

107. དམ་ཚིག་གསལ་སྒྲོན་ (118). Illuminating lamp of the holy word (or vow).

108. དྭགས་པོ་བཀའ་འབུམ་ (87). The hundred thousand (=collected) words (writings) of (the Lama of) Takpo (a country North of Bhutan). Namthar, Kagyü. See Nos. 109, 213.

109. དྭགས་པོ་དགེ་བཤེས་བློ་བཟང་སྦྱིན་པའི་བློས་བླངས་དཀར་ཆག་ (177). List of the effusions (inspirations, outpourings = བློས་བླངས་) of the Geshe Lozangjinpa of Takpo. Geluk. See above.

110. དུས་འཁོར་དྲི་མེད་འོད་རྒྱན་ (21). The spotless bright ornament of the Kālacakra See next.

111. དུས་འཁོར་རྣམ་བཤད་དྲི་མེད་འོད་རྒྱན་ (119). The spotless bright ornament of the various explanations of (commentaries on) the Kālacakra. Probably the same as the previous number, or its commentary.

112. དྷརྨ་སེངྒེ་གསུང་ (86). Words, or utterances of, or 'things spoken by' Dharmasiṃha (a Lama from Kham). Dzokchen. Here གསུང་ seems not to stand for གསུང་འབུམ་ but rather for བསླབ་བྱ་ See also Nos. 54, 55.

113. བདག་ཆེན་བློ་གྲོས་རྒྱལ་མཚན་གྱིས་རྣམ་ཐར་ཚར་ཆེན་གྱིས་མཛད་པ་ (140). Biography of the great Lord Lotögyaltshan (a Sakya Lama), by Tsharchen. Sakyapa. (The first གྱིས་ = གྱི་). See No. 119.

114. འདར་ལོ་ཙཱ་བའི་དབྱངས་ཅན་སྒྲ་ཊི་ཀ་ (203). The Lotsava from Dar's commentary on the Sarasvatī shabda. There are two सारस्वतव्याकरणसूत्र in the Tanjur. mdo, vol. ཛོ་, 134, immediately before Pāṇini, who ends the volume. Both have the same title, as well in Sanskrit as in Tibetan. They seem to be identical, but Cordier states that the second

has the Sanskrit text and an auto-commentary added, as well as an introduction and appendix. In Cordier's copy the first text covers 9 leaves and the second 135 leaves. The Dar-Lotsava (Dar, name of a place or country) is one of the translators, whose full name is to be found in Cordier. The inclusion of this work in our lists again proves that grammatical studies, and contact with Sanskrit grammar, are still alive in Tibet. See No. 167.

115. འདུ་བའི་སྡོམ་ཚིག་རྒྱས་བསྡུས་ (10). As in next title འདུ་=འདུལ་? Full and short compendium (summary, extract) of the Vinaya (?). See Nos. 116, 147.

116. འདུ་བའི་ཞི་སྟོད་ཞི་སྨད་ (3). Probably འདུ=འདུལ་ and ཞི=གཞི་ The upper and lower points (bases, mūla) of the Vinaya (?) (or : the two-fold tenor=āgama. vastu. of, etc.). See Nos. 115. 147.

117. འདུ་ར་བཀའ་གདམས་སྙི་འདུས་ (27). The concentrated essence (all the chief points) of counsel to the novices. In the title འདུ་ར་=འདུ་ར་བའི་. The meaning of འདུ་ར་བ་= the minor clergy, clerical candidates, tapas. See No. 120.

118. རྡོ་རྗེ་ཤུགས་ལྡན་གྱི་གསོལ་མཆོད་ (176). Formulas of worship to Dorjeshukdan (Vajravega?, a dharmapāla ?). Geluk

119. རྡོ་རིངས་པ་ཀུན་བཟང་ཆོས་ཀྱི་ཉི་མའི་རྣམ་ཐར་ཚར་ཆེན་བློ་གསལ་རྒྱ་མཚོས་མཛད་པ་ (135). Biography of Lama Kunzang Chökyinyima of Doring, written by Lama Losälgyatsho. Said to be the same as the author of No. 113. Doring, the house of a noble family at Lhasa.

120. སྡེ་སྲིད་བསྡུས་གྲྭ་ (194). The book by the Desi, (i.e. སངས་རྒྱས་རྒྱ་མཚོ་) for the use of the body (assembly) of novices. མཚན་ཉིད་, philosophy. See Nos. 117, 121, 122, 152.

· 121. སྡེ་སྲིད་པའི་མཚམས་སྦྱོར་ལྔ་པའི་འགྲེལ་པ་ (202). Commentary on the five ways of composition, by the Desi (as above No. 120 and below 122). མཚམས་སྦྱོར་=ལེགས་སྦྱར་, composition.

122. སྡེ་སྲིད་གསུང་འབུམ་ (56). Collected works of the Desi (as above). Namthar. The two previous numbers are in all probability contained in this collection. In our lists often a sungbum is mentioned in one place, whilst special treatises or chapters, ལེ་ཚན, from that sungbum, which are in separate demand, are entered elsewhere. For Tibetan bibliography the knowledge and study of these sungbums is of primary importance. Wassiliew has an interesting passage on these sungbums, called Yui-lou in Chinese. This is quoted in full by Dr Thomas in his Note mentioned in the introduction to these lists. Many Tibetan works known to Western scholars separately are only extracts from such collections; so for instance the "Road to Shambala" recently published by Grunwedel. In the printing institutions such separate chapters for which there is a special demand are printed and sold separately. Our list reflects to a certain extent what part of the sungbums is actually read at the present day. Each le-tshan from a sungbum has its own abbreviated marginal title, but also a serial letter-number indicating the volume or poti of which it forms part. But the marginal title does not disclose the author and consequently does not lead to an identification of the sungbum itself.

123. སྡེབ་སྦྱོར་རིན་ཆེན་འབྱུང་གནས་ཀྱི་འགྲེལ་པ་ (149). Commentary on the Jewel-source of composition, or metre. Probably commentary on the छन्दोरत्नाकरनाम in Tanjur, mdo ཤེ་ 117.

124. ནམ་མཁའ་བསྟན་སྐྱོང་ (47). The infinite protector of the teaching. (Said to be a god, not a Lama.) See next number. ནམ་མཁའ=ནམ་མཁའ་འདྲ་པོ་, heavenly, has in Tibetan another idiomatic value than in English, and means infinite, as the expanse of the heavens.

125. ནམ་མཁའ་བསྟན་སྐྱོང་གི་སྦྱོར་ཆོས་རྩ་འགྲེལ་ (208). Text and commentary of the Yoga-doctrine (?) of the Infinite protector of the teaching. See previous number.

126. པད་དཀར་ཞལ་ལུང་མ་བུ་ཚང་མ་ (156). Complete oral

teachings of (Lama) Pekar (White Lotus), both Mother (text ?) and Son (commentary, elaboration, additions, appendix). Not the well-known Saddharmapuṇḍarīka Sūtra, but the work of an incarnation in སྟོད་, upper Tibet, i.e. in the Ladak region. བུ་ is here not necessarily a commentary of the text, but in the volume the མ་ is the chief part, and the བུ་ the rest of the volume. The terms are used with reference to the volume as a material unit, not with reference to the nature of the contents. Dzokchen ? See No. 177. I leave open the question in how far the above explanation is contradictory to what Csoma says in his Gramm., p. 191.

127. པདྨ་བཀའ་ཐང་ (151). Complete, full. ope[illegible] displayed words of Padma = Padmasaṃbhava. The primary meaning of ཐང་ is, as explained under No. 13. put. displayed on the plain, clearly visible to all, and no longer hidden as before, i.e. laid bare, exposed. But from this primary meaning a development makes the term to be also understood as ཐང་=ཐང་ཀ་=རྒྱ་ཆེན་པོ་, full. wide, expanded This is the popular title of all writings relating to or emanating from Padmasaṃbhava, and not only of the well-known collection of ' Five Chapters," སྡེ་ལྔ་. See Nos. 13–15. Nyingma.

128. པདྨ་བརྫའི་གཏད་རུལ་ཆོག་ (174). Ritual for the annihilation (lit. rötting, putrefaction) of evil spells, by Lama Padmavajra. Kurim Nyingmapa. མནན་གཏད་ or གཏད་བཙུག་པ་, to cast spells on, imprecate, to curse, conjure up evil maledictions. གཏད་ is here བྱད་.

129. པཎ་ཆེན་ཡེ་ཤེས་རྩེ་མོའི་རྣམ་ཐར་རྒྱལ་བ་དགེ་འདུན་རྒྱ་མཚོས་མཛད་པ་ (152). Biography of Mahāpaṇḍita Yeshetshemo (not a Tashilama), written by Gyalba Gendüngyatsho (the second Dalai Lama). Namthar. Gelukpa.

130. ཕྲ་སྟིའི་ཕར་ཕྱིན་དྲིས་ལན་ (197). Unexplained. Cf. the entry in S. C. D. Dict under ཕྲ་ཏི་པོ་དང་གི་ ? Questions and answers about the Pāramitās, by Prati ?

131. དཔེ་ཆོས་རིན་ཆེན་སྤུངས་པ་ (78). Jewel heap of moral examples.

This is probably the same work as the one which is popularly known as དཔེ་ཆོས་ only. I possess an incomplete umed copy of this work with a slightly different title, དཔེ་ཆོས་སྣ་ཚོགས་སྤུངས་པ་. It is a record of sayings and moral stories by a disciple named ཕོ་བྲང་སྒོངས་པ་, of Potova, and constitutes a companion volume to No. 148 of this list.

Since writing the above I have received a complete print of this work, with the title as in the Lama's list, 182 leaves, from very old and worn-out blocks. Marginal title དཔེ་ཆོས་

132. སྤང་ལུང་གསུང་འབུམ་ (160). Collected works of (probably Lama) Panglung. Namthar. There is a lotsava དཔང་བློ་གྲོས་བརྟན་པ་.

133. སྤོས་དཀར་སྤྲུལ་སྐུའི་འཇིགས་བྱེད་བསྐྱེད་རྫོགས་ (173). Meditation on Yamāntaka, according to (Lama) the Incarnation Pökar (pròper name, White Incense). Geluk. མཚམས་ཀྱི་དཔེ་ཆ་, manual of the form of meditation styled མཚམས་. See dicts. Geluk. See next.

134. སྤོས་དཀར་སྤྲུལ་སྐུའི་མ་མོའི་འཁྲུག་སྐོང་ (219). The appeasement (satisfaction) of the anger of the exalted Mother (Kālī) according to the Incarnation (Lama) Pökar. Kurim. Geluk

135. སྤྱན་སྔ་བློ་གྲོས་རྒྱལ་མཚན་ (22). (Works, or biography ?, of Lama) Chänngalotögyaltshan (Royal Banner of learning before the eye. *sc* before the Buddha.)

136. སྤྱོད་འཇུག་འགྲེལ་པ་ (34). Commentary on entering on the (right) practice (or conduct). See next.

137. སྤྱོད་འཇུག་རྩ་འགྲེལ་ (77). Text and commentary, as above.

138. ཕ་བོང་ཁ་པའི་མཁའ་སྤྱོད་སྐོར་ (163). Concerning the conduct (leading to) heaven, according to (the book of) Phawongkha (a hermitage about a day North of Lhasa). Kurim.

139. ཕར་ཕྱིན་སྐབས་དང་པོ་ (41). First chapter on the pāramitās. མཚན་ཉིད་, philosophy.

140. ཕར་ཕྱིན་སྤྱི་དོན་ (7). Complete exposition of the pāramitās. མཚན་ཉིད་, philosophy.

141. ཕར་ཕྱིན་དབུ་མ་ཐལ་སྤྱོད་ (1). (Rendering altogether problematic): Method of revering the pāramitās of the mādhyamikas. The expression ཐལ་སྤྱོད་ has not been explained and the grammatical relation between ཕར་ཕྱིན་ and དབུ་མ་ is uncertain. མཚན་ཉིད་, philosophy.

142. ཕར་ཕྱིན་རྩ་ཊིཀ་ (8). Text and commentary on the pāramitās. May be anything of this large class of literature. Most probably from the Tanjur, first volumes of mdo.

143. ཕར་ཕྱིན་ལམ་ཁྲིད་ (9). Guide to the pāramitās. མཚན་ཉིད་, philosophy. See Nos. 146, 197.

144. ཕོ་བྲང་པར་ཐོ་ (180). Catalogue of the books printed in 'The Palace.' This is the most tantalizing title in our list This seems precisely the kind of print we have been looking for, but in this case the information is disappointingly vague. There are two 'Palaces,' ཕོ་བྲང་, namely of Potala and of Däpung, both in Lhasa. Either of these may be meant. We have now to try to obtain a copy of this catalogue. I am told that in Tibet such catalogues are very rare, so much so that I have been unable to obtain definite information as to the existence of any other than the above catalogue Of no other printing establishment in Tibet a catalogue of editions is known to my informants. On the other hand, most of the sungbums when they consist of many volumes have very

reliable indexes added to each volume, describing the full contents of each These are indispensible for checking the completeness of these volumes which are never numbered consecutively, but start with a fresh numeration for each component part, whilst the component parts themselves are not serially numbered In the introduction I have mentioned a similar list refering to works printed in Galdan Phüntsholing. (*Supra* p. 449) (See also Addenda, behind.)

145. འཕགས་ཧོད་ཡོན་ཏན་རྒྱ་མཚོའི་གསུང་འདུས་ཊིཀ (166). Extract of the works and commentary on the tantra of Ārya Höyöntan Gyatsho? Doubtful rendering འགྲེལ་པ, commentary.

146. བ་སོ་བའི་ལྟ་ཁྲིད (175). The guide to contemplation by (the Lama from) Baso ལྟ་སྒོམ་སྤྱོད་གསུམ are three stages of meditation. Baso, a village in Tsang, also name of བ་སོ་ཆོས་ཀྱི་རྒྱལ་མཚན according to S. C D See Nos 143, 196

147. བུ་སྟོན་འདུ་བའི་ལེགས་ཁྲིད (74). Like in Nos. 115, 116, འདུ=འདུལ་? If so: Excellent guide to the discipline by Lama Buton= རིན་ཆེན་གྲུབ.

148. བེ་འབུམ་འགྲེལ་པ (82). Read བུམ, also བེའུ་བུམ. Commentary on the cow's nipple. According to S C. D. a general term for 'scripture' Perhaps identical with next number

Since writing this I have received from Tibet a copy of the བཀའ་གདམས་ཀྱི་མན་ངག་བེའུ་བུམ་སྔོན་པོའི་འགྲེལ་པ (བཞུགས།), a Däpung print (Lhasa), 274 leaves. This is evidently the same work. It is a collection of edifying stories by a pupil of པོ་ཏོ་བ, and is a companion volume to a well-known similar work the དཔེ་ཆོས, by ཕོ་བྲང་སྔོང་སཔ, a co-disciple of the same teacher, both works recording the oral teachings of Potowa. See No 131.

149. བེའུ་བུམ་སྔོན་པོའི་རྩ་འགྲེལ (114). Text and

commentary of the blue cow's nipple. S. C. D.: the ancient book on religion and religious history of the Kadampa school, compiled by དགེ་བཤེས་དོལ་རིན་པོ་ཆེ་. See previous and next numbers.

150. བེའུ་འབུམ་སྔོན་པོའི་འགྲེལ་པ་ (23). འབུམ་=བུམ་. See previous two numbers. Probably identical with No. 148.

151. བཻ་དཀར་རྩིས་ (57). (Astronomical) calculations (called) White Vaiḍūrya = བཻ་རྜུ་ (or ཌུ)རྱ་དཀར་པོ་. The term vaiḍūrya, in Tibetan booktitles means no more than 'gem,' precious. There are many different works with this word in the title, often followed by a colour name. Abbreviated as བཻ་. See next two numbers. For the present number cf. Schmidt and Böhtlingk, Nos. 472–473. See also Csoma Grammar, p. 191,

152. བཻ་སྔོན་ (60) The blue vaiḍūrya. Probably medicine. See above and below, also No. 57. Cf Schm. and B. Nos. 486–488. See Csoma, Grammar, p. 191, Waddell No. 446

153. བཻ་སེར་ (58). The yellow vaiḍūrya. Subject unknown. See above. Thomas (No. 7, quoted from Wassiliew), has a བཻ་ཌཱུ་རྱ་སེར་པོའི་མེ་ལོང་ by སངས་རྒྱས་བདེ་སྲིད་རྒྱ་མཚོ་, account of the sects founded by Tsongkhapa. See above Nos 120–122 སྡེ་, not བདེ་.

Since writing the above I have received from Tibet a Däpung print of this work, 419 leaves. Its full title is དཔལ་མཉམ་ མེད་ རི་ བོ་དགའ་ ལྡན་པའི་བསྟན་པ་ཞྭ་སེར་ཅོད་པན་འཆང་བའི་ རིང་ལུགས་ཆོས་ཐམས་ཅད་ཀྱི་རྩ་ བ་ གསལ་ བར་ བྱེད་ པ་ བཻ་ཌཱུར་སེར་པོའི་མེ་ལོང་ཞེས་བྱ་བ་བཞུགས་སོ། Described as a history of the Yellow-hat sect.

154. བོད་ མཁར་ མི་ ཏི་བ་དོན་ གྲུབ་ རྒྱལ་མཚན་གྱི་ རྣམ་ཐར་མི་

ཕམ་ཆོས་ཀྱི་རྒྱལ་མཚན་གྱིས་མཛད་པ་ (137). If མཁར་ is a mistake for མཁས་: The biography of the Tibetan scholar Maitripa Töndubgyaltshan, written by Miphamchökyigyaltshan. མི་ཕམ་ is Maitreya, and so the latter name means: The royal banner of Maitreya's religion, evidently a religious play of words in this case. S. C. D. records a Tibetan word མི་ཏྲི་ with the meaning: love, friendship. So མི་ཏྲི་པ་ may be a Sanskritised Tibetan designation for a follower of Maitreya, or one whose ཡི་དམ་ is Matreya.

155. བྱམས་ཆོས་སྡེ་ལྔ་ (11) The five chapters of Love-religion, i.e. Lama བྱམས་ཆེན་ཆོས་རྗེ་ཤཱཀྱ་ཡེ་ཤེས་, the founder of the Sera monastery.

156. བྱམས་པ་ཡོན་དར་གྱི་བདེ་ལམ་ཟིན་བྲིས་ (193). Original (first draft, autograph) of the Way to Happiness by Lama Jampayöntan. (ཟིན་བྲིས་ has also the meaning of memorandum, notes, i.e. in order not to forget, to fix in the memory)

157. བྲག་ཡབ་བློ་བཟང་བསྟན་པའི་བསེ་ཁྲབ་གསོལ་མཆོད (197). Prayer and offering book (གསོལ་མཆོད་) to (the Dharmapāla) Rhinoceros-mail, by (Lama) Lozangtanpa from Takyab. Kurim. According to the Dict. བྲག་ཡབ་ is a place in Kham. བསེ་ཁྲབ་=བསེ་རུའི་ཁྲབ་.

158. བླ་མ་ལྷག་བསམ་གྱི་སུམ་རྟགས་འགྲེལ་པ་ (147). The grammatical commentary of Lama Lhaksam (Excellent Soul), a Lama from Lhasa, of recent date.

159. བློ་སྦྱོང་བརྒྱ་རྩ་ (205). Hundred (points concerning) the purification of the soul.

160. id. (84).

161. དབང་ཆེན་བརྒྱ་རྩ་ (30). Hundred (points concerning) the greater ablutions, initiations (abhiṣeka).

162. དབངས་ལོ་ཆེན་པོ་འི་བརྡའ་སྤྲོད་སྙིང་པོ་རང་འགྲེལ་བཅས་ (201). The vyākaraṇa essence, together with his own commentary thereon, by the great Lotsava of Wang. རང་འགྲེལ་ may also mean: the work itself and its commentary. This seems to be the Lotsava from དཔང་ (not དབངས་) who was responsible for the revision of the translation of Daṇḍin's Kāvyādarṣa as now in the Tanjur, and whose name is given as དཔལ་ལྡན་བློ་གྲོས་བརྟན་པ་, Shrīmat Sthiramati, "expert in Sanskrit grammar." See below.

163. དབང་ལོ་ཆེན་པོ་འི་ཚོགས་གསུམ་གསལ་བ་ (126). Here also probably དཔང་ as above. The ཚོགས་གསུམ་ is unexplained. An index to the names in Cordier's Tanjur would probably lead to an explanation, but alas, how much information is now not locked up, almost untraceable, in his two splendid volumes! The title might, as it stands, be translated as: the clear three assemblies ? of the great Lotsava of Wang.

164. དབུ་མ་རྩ་ཤེལ་གཞུང་འགྲེལ་ (6). Text and Commentary of the crystal mūla of the Mādhyamika philosophy. This reminds us of the དབུ་མ་རྩ་བའི་ཚིག་ལེའུར་བྱས་པ་ཤེས་རབ་, the Prajñā nāma mūla madhyamaka kārikā, in the Tanjur, mdo ཙ, 17, or its numerous derivates in that and the following volumes.

165. དབུ་མའི་ཟིན་བྲིས་ (5). Notes on the Mādhyamaka system. Philosophy, Geluk.

166. དབུས་སྨྱོན་ཧེ་རུ་ཀའི་རྣམ་ཐར་ (152). The biography of the frantic Heruka from (the province of) Ü. Heruka is a god, but the name is also given to an ascetic or yogi who dresses as a Heruka and is Heruka-inspired. It is said that here a member of the latter class is meant There are two of them known as the Ü Heruka (in Lhasa) and the Tsang Heruka (in Shigatse). They are regular 'incarnations,' and their method or manifestation is that of frenzy or madness. Bhutanese Kagyüpa. See No. 171.

167. དབྱངས་ཅན་སྒྲ་མདོ་, (67). Probably the सारस्वतव्याकरणसूत्र (so Cordier) in Tanjur, mdo, vol. ཚོ, 134. (Schiefner सरस्वती°). See No. 114.

168. དབྱངས་འཆར་ལག་ལེན་འོད་ཟེར་བརྒྱ་པའམ་ནོར་བུའི་ཕྲེང་བ་དྲུང་བ་རྡོ་རྗེ་དང་སྡེ་སྲིད་པའི་མཚན་དང་བཅས་པ་ (200). The hundred rays of light (illuminating) the practice of the (work called) the arising of sound, or string of jewels, together with the names of the Dungva-vajras and Desis (Regents). (Unsatisfactory and uncertain) ཀྱིས་དཔེ་, fortune telling, omens, sooth-saying. དབྱངས་འཆར་ is explained as follows: དབྱངས་ stands for དབྱངས་ཅན་ལྷ་མོ་, the Goddess Sarasvatī. In some way auguries are derived in connection with sounds arising from her throat. The expression དྲུང་བ་རྡོ་རྗེ་ is obscure, probably a title or designation དྲུང་བ་, better དྲུང་པ་ may stand for the following four expressions: དྲུང་རམ་པ་, a clerical degree; དྲུང་ཡིག་, writer, clerk, secretary; ཞབས་དྲུང་, servant (hon.) or the son of a སྐུགས་པ་; སྐུ་དྲུང་པ་, assistant, aide-de-camp.

169. འབྲས་ལྗོངས་བླ་མ་ཨུ་རྒྱན་གྱི་སྙན་ངག་སུམ་རྟགས་ (99) Poetry and grammar by the Sikhim Lama Ugyan.

170. འབྲུག་ཐམས་ཅད་མཁྱེན་པ་པདྨ་དཀར་པོའི་གསུང་འབུམ (92). The works of the omniscient Bhutanese Lama White Lotus. Kagyü.

171. འབྲུག་གཙང་སྨྱོན་དབུས་སྨྱོན་ (107). Story of the frenzied ones living in the provinces of Tsang and Ü, both born in Bhutan. The one is a kind of Tibetan Till Eulenspiegel, known as ཨ་ཁུ་སྟོན་པ་, the other is known as ནང་པའི་དྲུང་

(in which དྲུང་ is a Tsang idiom for Mr., Esq., Saheb, Babu, in Ü ལགས་). There is an extensive literature devoted to each one of the two See No. 166.

172. མ་ངེས་ཆོས་འཁོར་ (108) Probably འཁོར་=སྐོར་. Concerning the untrue religion. Might be interesting if it were polemics against the Chilingpas or Lalos, but may, of course deal with internal polemics.

173. མ་ཎི་བཀའ་འབུམ་ (43). The well-known Maṇikambum. Rockhill's data about it are still the fullest up till now.

174. མང་ཐོས་ཀླུ་སྒྲུབ་རྒྱ་མཚོའི་རྣམ་ཐར་རྗེ་རང་ཉིད་ཀྱི་མཛད་པ་ (138) The biography (or works) of the well-informed Ludub gyatsho, written by His Eminence himself. ཀྱི་=ཀྱིས་.

175. མྱུར་ལམ་སྔོན་འགྲོའི་སྦྱོར་བའི་ཆོས་དྲུག་ (183). The six themes (subjects, topics) on the manner of the quick preparation of the preliminaries (or necessary preliminaries) (for salvation ?).

176. དམིགས་བརྩེ་མའི་ལས་ཚོགས་ (39). Various (ceremonies =ལས་, works) connected with the Unfathomable-love verse (of Tsongkhapa). (So called after the initial words. See my Minor Tibetan Texts I, B.I., p. 75.) Geluk.

177. རྩིས་ཡིག་པད་དཀར་ཞལ་ལུང་ (65). Oral teachings (authentic utterances) on astronomy (?) by Lama Pekar (White Lotus). རྩིས་དཔེ་, astronomy (?) See No. 126.

178. ཚད་མ་རྣམ་འགྲེལ་ (2). Pramāṇa-vārtika. Tanjur, mdo, ཅེ་, 95. See Vidyābhuṣaṇa, A history of Indian Logic. མཚན་ཉིད་, philosophy.

179. མཛད་བརྒྱ་དཔག་བསམ་འཁྲི་ཤིང་ (17). The creeper of the hundred inconceivable deeds. This seems to be the

same as the བྱང་ཆུབ་སེམས་དཔའི་རྟོགས་པ་བརྗོད་པའི་དཔག་བསམ་གྱི་འཁྲི་ཤིང་, Bodhisattvāvadānakalpalatā, by Kṣemendra, Tanjur mdo. གེ་ 93 (and not ཧ as in S. C. D. Dict.) edited in Sanskrit and Tibetan by Sarat Chandra Das in the Bibliotheca Indica; unless it is the shorter Tibetan prose work, giving a simpler form of the same work, also edited by Das in the same series. My informants do not know of other works with a similar name. S. C. D. gives another title in his Dict.: རྟོགས་བརྗོད་རིན་པོ་ཆེ་དཔག་བསམ་ཁྲི་ཤིང་.

180. བཞད་པ་རྡོ་རྗེའི་གསུང་འབུམ་ (105). The works of Milaräpa བཞད་པ་རྡོ་རྗེ་=མི་ལ་རས་པ་ Namthar Kagyü See No. 91.

181. ཟུར་ཁ་བརྒྱ་རྩ་ (31). Unexplained. Corner (or side)—mouth—hundred.

182. ཡར་འབྲོག་པ་རིན་ཆེན་ཏོག་གིས་མཛད་པའི་མན་ངག་དབང་པོའི་རྡོ་རྗེ་དང་ཡེ་ཤེས་རྡོ་རྗེའི་ཐོག་ཏོག་ཆེན་པོ་ (122). The great top-knot (ཐོག་ཏོག་) of (the) Indriya Vajra and Prajñā Vajra concerning the teaching (instruction) given by (Lama) Rinchentok from (the country of) Yardok (halfway between India and Lhasa, near Yamdok Lake). Obscure. ཐོག་ཏོག་ seems to be the abbreviated name of a book which is probably a commentary or extract of two other works, the Indriya Vajra and Prajñā Vajra, so that these are here not taken as names of Lamas.

183. ཡོངས་འཛིན་ཡེ་ཤེས་རྒྱལ་མཚན་གྱི་རྣམ་ཐར་ (145). The biography (works) of Yongdzin Yeshegyaltshan. The fuller name of this teacher, which I found elsewhere, is ཡོངས་འཛིན་པཎྜི་ཏ་ཆེན་པོ་ཡེ་ཤེས་རྒྱལ་མཚན་དཔལ་བཟང་པོ་. In the seventh volume, ཛ་ of the collected writings of the fourth Teshu

Lama, a བསྟོད་པའི་ཕྲེང་བ་ on him is to be found. He was a teacher of the seventh Dalai Lama, འཇམ་དཔལ་རྒྱ་མཚོ་. See Nos. 40, 184, 185.

184. ཡོངས་འཛིན་ཡེ་ཤེས་རྒྱལ་མཚན་གྱི་གསན་ཡིག་ (189). Notes on oral teachings heard by Yongdzin Yeshegyaltshan (from different Lamas). གསན་ཡིག་ as elsewhere in this list = ཉན་ཡིག་. See Nos. 183, 185

185. ཡོངས་འཛིན་ཡེ་ཤེས་རྒྱལ་མཚན་གསུང་འབུམ་ (90). The collected works of Lama-teacher Yeshegyaltshan. See Nos. 183, 184.

186. ཡོལ་མ་རི་དཔོན་རིན་པོ་ཆེ་གཞོན་ནུ་བློ་གྲོས་ཀྱི་རྣམ་ཐར་བློ་གྲོས་རྒྱལ་མཚན་གྱིས་མཛད་པ་ (136). Biography or works of the Precious Mountain Master of Yöl, named Zhönnulotö, written by Lotögyaltshan. Some of the umed letters in this title are not clear in the MS. If རི་དཔོན་ is written, this stands probably for རི་ཁྲོད་པའི་དཔོན་པོ་, but if རིག་དཔོན་ is written, the expression means Master of Wisdom or Learning.

187. གཡའ་སེལ་ (59). The rust-remover. (Perhaps a medical work according to my informants, but Csoma, Gramm. p. 191, quotes a work with this title by Desi Sangyä gyatsho and says that this work contains the author's answers to the objections of several learned men who criticised his works.)

188. གཡུ་ཐོག་ཆོས་སྐོར་ (157). About Yuthok's book. The Yuthok doctor lives near the Turquoise Roof Bridge in Lhasa. A medical book. See Waddell's No. 347.

189. རྭ་སྒྲེང་བསྟན་པ་རབ་རྒྱས་ (83). (The works of Lama.) Tanparabgyä of the Radeng monastery. See next number.

190. རྭ་སྒྲེང་བསྟན་པ་རབ་རྒྱས་ཀྱི་གསུང་འབུམ་ (215). Collected works of (Lama) Tanparabgyä of the Radeng monastery (two days North of Lhasa)

191. རཱ་ལོ་ཙཱ་བའི་རྣམ་ཐར་ (172). Biography of the Indian translator Rā, or from Rā. Titles and names like these will be immediately verifiably as soon as we have proper indexes to the existing Tanjur and Kanjur catalogues. Now an identification is largely a matter of chance unless time is spent out of proportion to the importance of the result In Tibetan literary history there are several different Rā scholars.

I possess a namthar of Rā lotsava, in one volume, of 151 leaves, bought in Pharijong from an itinerant bookseller from Lhasa. I have been told that there are different namthars of this name. My copy is entitled: མཐུ་སྟོབས་དབང་ཕྱུག་རྗེ་བཙུན་རཱ་ལོ་ཙ་བའི་རྣམ་པར་ཐར་པ་ཀུན་ཁྱབ་སྙན་པའི་ང་སྒྲ་ཞེས་བྱ་བ་བཞུགས་སོ ༎ The marginal title is རཱ་ལོའི་རྣམ་ཐར་. The syllable རཱ=ར་ is explained as the name of a country. From the above book it appears that the Lotsava's full name was རཱ་ལོ་རྡོ་རྗེ་གྲགས་. His pupil was རཱ་ཆོས་རབ་. The pupil of this one again, རཱ་འབུམ་སེང་. The latter's pupil was རཱ་ཡེ་ཤེས་སེངྒེ་; who is the author of the namthar In the body of the work there is a legend which explains the name རཱ་ in connection with the horns of འཇིགས་བྱེད་ or Yamāntaka, whose form the Lotsava assumed at the occasion of a picturesque incident in his career. This seems at variance with the first explanation as a geographical term

192. རས་ཆུང་རྣམ་ཐར་ (106) Biography of Lama Rächung, Milaräpa's disciple. Kagyu

193. རི་ཆོས་ (94). The mountain book. ཆོས་ often book. རི་ here probably རི་ཁྲོད་ བསྒྲགས་བྱ, teaching, instruction.

194. རིགས་བརྒྱ་སྤྲུལ་སྐུའི་སྲི་མནན་ཆོག་ (209). Ritual of the incarnation of the Rikgya monastery for the subjection of the Tamsi-gnomes (སྲི་=དམ་སྲི་ a kind of བདུད་).

195. རིན་ཆེན་གཏེར་མཛོད་ (93). Precious treasure. Kagyü. A voluminous collection of about a hundred volumes, a kind of modern Tanjur, described as a religious miscellany or cyclopedia containing works pertaining to various sects, produced in the Kagyupa monastery མཚུར་ཕུ་, a day North of Lhasa. Said to have been only once printed before, in Kham (Derge), and now some 6 or 7 years ago completed for a second time in Tshurphu. See S. C. D Dict. མཚུར་ is said to be a dialectical variant of མཚོར་ so that the name would mean the Lake Cave. See Introduction, p. 468.

196. ལམ་ཁྲིད་མྱུར་ལམ་ (158). The quick guide (to Heaven). No details, a frequent title There are ལྷ་ཁྲིད་, ལྷུ་ཁྲིད་, ལམ་ཁྲིད་ and perhaps other guides of this kind. See next number and Nos. 31, 33.

197. ལམ་ཁྲིད་གསེར་གྱི་ཡང་ཞུན་ (129) Twice refined gold about the guide to Heaven. ཡང་ཞུན་, twice molten, doubly refined. ཁྲིད་ཡིག་, guide. See Nos. 143, 146.

198. ལམ་རིམ་ཆེ་ཆུང་ (36). The greater and lesser steps on the path. Lamrim is a very frequent title and the work mentioned here may, in consequence, be by one of a great number by different authors. Tsongkhapa's Lamrim is the most famous of all works known by this name. See next number and No. 9.

199. ལམ་རིམ་ཞི་དྲག་ (91). The peaceful and fearful steps on the path, or otherwise, the steps on the path with reference to the peaceful and fearful Deities. See previous number.

200. ལོ་ཆེན་ཆོས་སྐྱོང་བཟང་པོའི་སུམ་རྟགས་འགྲེལ་པ་ (124). Commentary on the grammatical treatise by the great translator Chökyong-Zangpo, Dharmapālabhadra.

201. ལོ་ཙཱ་བ་བློ་ལྡན་ཤེས་རབ་ཀྱི་རྒྱུད་བླའི་བསྡུས་དོན་ (120).

Short account of the Lama succession (doctrinal tradition) of Translator Lodansherab. རྒྱུད་བློ་=བློ་རྒྱུད་ བློ་=བློས་.

202. བཤེས་སྤྲིངས་ཊཱིཀ་རེད་མདའ་བས་མཛད་པ་ (165). Commentary on the Sheting (Friendly Epistle) written by Lama Reda (=རེ་མདའ་, arrow of hope?). This may be a commentary on Nagārjuna's famous epistle, བཤེས་པའི་སྤྲིང་ཡིག་, mdo, གི་, Vol. 33. Note that as ཡིག་ is written for ཡི་གེ་. so also ཊཱིཀ་ is written for ཊཱི་ཀ་. The latter is no mistake. See next number. In the Tanjur the title is བཤེས་པའི་སྤྲིན་ཡིག་. in Vol. ངེ་ and བཤེས་པའི་སྤྲིང་ཡིག་ in Vol. གི་ (according to Cordier.)

203. བཤེས་སྤྲིངས་རྩ་འགྲེལ་ (120). Text and commentary as above.

204. ས་སྐྱའི་ཆོས་འཁོར་ (100). Circle (garland) of teachings of the Sakya (monastery). Sakyapa.

205. སི་ཏུ་པཎ་ཆེན་གྱི་སུམ་རྟགས་འགྲེལ་པ་ (146) Commentary on the grammatical treatise of the great Situ Paṇḍit (Situ, a place in Kham) If it is the same work as the one edited by Sarat Chandra Das in his Grammar, then the translation is rather: the commentary on (Thönmi Sambhoṭa's) grammatical treatises, by the Situ Paṇḍit.

206. སེང་གདོང་གཏོར་ཆོག་མཁའ་འགྲོའི་དགོངས་རྒྱན་ (162) Torma ritual to (the Ḍākinī) Lion-face, (called) the Ḍākinī's soul-ornament. Kurim. ཆོག་=ཆོ་ག་.

207. སེར་འབྲས་དགེ་གསུམ་བཀྲས་ལྷུན་རྒྱུད་གྲྭ་གཉིས་བཅས་ཀྱི་དཀར་ཆག་ (179). Catalogue (=description, history) of the three monasteries Sera, Däpung (both in Lhasa) and Gedan (S.E. of Lhasa), of Tashilhumpo, and of the two mantra schools (in Lhasa). All big monasteries have such a "catalogue," which describes both their contents as well as their history. Geluk. See Nos. 212 and 215.

208. སློབ་དཔོན་རིན་པོ་ཆེའི་རྣམ་ཐར་ཏཱ་ར་ན་ཐས་མཛད་པ (150). The biography of the Precious Teacher, written by Tāranatha. Which Tāranatha, is not evident; all the successors of the incarnation bear the same name. སློབ་དཔོན་རིན་པོ་ཆེ་ seems to be Padmasaṃbhava, as no other Tibetan teacher appears to be known under that appellation. Nyingma.

209. སློབ་སྤྲིངས་ (121). Letter, epistle of instruction or to a pupil. Probably the སློབ་མ་ལ་སྤྲིངས་པའི་སྤྲིང་ཡིག་, **शिष्यलेख**, in Tanjur, Vol. གི་, 33. Author Candragomi.

210. གསང་སྡེ་འཇིགས་གསུམ་ (73). Ritual book connected with the three Gelukpa Yidams, གསང་འདུས། བདེ་མཆོག། འཇིགས་བྱེད། or Guhya samāja Samvara, Yamāntaka Kurim. Geluk. སྡེ་ must be བདེ་.

211. གསན་ཡིག་ (49). Notes on oral teachings. No details. See No. 78.

212. གསེར་གདུང་རིན་པོ་ཆེའི་དཀར་ཆག་ (69). Guidebook to the Golden (chapel in which are the) Remains of the (fifth) Tashi Lama. The other four mausolea have only small guide books but this one is bulky, of perhaps a hundred pages or leaves. This mausoleum is popularly called འཛམ་གླིང་རྒྱན་གཅིག་, the first (chief, unique) ornament of the world. See No. 207.

213. ལྷ་སྡིངས་རྒྱལ་སྲས་པའི་དྭགས་པོ་ཆོས་འབྱུང་ཁ་སྐོང་ (199). Supplement (ཁ་སྐོང་) to the history of the rise of the faith in (the country of) Takpo, (written by) the Prince of the Lhading (country). See Nos 108–109.

214. ལྷ་བཙུན་དོན་འགྲུབ་རྒྱལ་མཚན་གྱིས་རྗེ་རིན་པོ་ཆེའི་རྣམ་ཐར་ (170). Biography of His Precious Highness (Tsongkhapa) by (Lama) Lhatsündöndubgyaltshan. I think that ལྷ་བཙུན་

is a title, or may, at all events, sometimes mean augur, soothsayer, as in the table accompanying Bacot's publication on the cries of the crow, J.A., 1913.

215. ལྷ་སའི་དཀར་ཆག་ (178). Guidebook to Lhasa. Evidently the work on which Waddell based his article in the J.A.S.B., Vol. 64 (1893): 'Description of Lhāsa cathedral.' See also S. C. D.'s list A, No. 20.

This work has recently been edited and translated by A. Grünwedel, Heidelberg (Sitzungsberichte of the Heidelberg Academy), 1919. The full title is ལྷ་ལྡན་སྤྲུལ་པའི་གཙུག་ལག་ཁང་གི་དཀར་ཆག་ཤེལ་དཀར་མེ་ལོང་ (བཞུགས་སོ་). This does not mean: "Ein kristallheller Spiegel: Katalog des Tempelklosters, das durch überirdische Kraft Götterwohnung geworden ist." This is mere dictionary-translation. The rendering should rather be "Systematic description, clear (or pure) as crystal, of the convent (vihāra) of (= founded by) the Incarnation (Srongtsangampo) in (or of) the Town of the Gods (namely, the many—and especially five, on account of which there is the synonym ལྷ་ལྡན་—sacred images for which the town was famous and which gave rise to the name Lhaśa). The short marginal title of the booklet is དཀར་ཆག་ལྷ་ལྡན་ and the volume or part number in the collection of which it forms part is ཛ་ or 19. In titles ཤེལ་དཀར་, lit. crystal, means spotless (and especially perfect, without blemish, faultless); and མེ་ལོང་, lit. mirror, means clear, perfectly intelligible. The English idiom clear as crystal (kristallhell) already accounts for the element མེ་ལོང་ The word དཀར་ཆག་ represented by varṇa in the Sanskrit equivalent title, which almost certainly stands for varṇanā, means not much more than "classification," "arrangement" or "grouping." The idea seems that of sorting out clearly in separate and appropriate heaps or bundles. Tibetans relate the syllable ཆག་ to ཆག་པ་, bundle, tuft, bunch, cluster, but in connection with flowers, bouquet, nosegay, posy. If we similarly reconstitute the devamān in the Sanskrit title as devamāna, then this Sanskrit title of the block-print evidently stands for a Tibeto-Buddhist-Sanskrit construction "Devamāna-nirmānasya vihāra-varṇanā sphaṭika-śuklaḥ ādarśa viharati sma," corresponding to a classical Sanskrit "Devamāna-nirmāṇa-vihāra-varṇanā sphaṭika-śuklaḥ ādarśa iti."

The corruptions in the title as they are now in the printed text have probably crept in in latter times and need not be ascribed to its first drafter.

216. ལྷན་ཐབས་ (63). "Extra," "Supplement," "Addenda." Not specified. The word is in J.'s. Dict. and he says that it is the title of a medical work. But the expression may be used for any supplement to any work, and is generally applied to any smaller work following a larger one in the same volume.

217. ལྷོ་རྒྱུད་སྔོན་འགྲོའི་སྒྲོར་བའི་ཆོས་དྲུག་ (184). The Lamaistic succession in the South (= Bhutan) of the six schools formerly practised. སྒྲོར་བའི་ཆོས་དྲུག་ seems also to be the title of a separate work, with the meaning as in the above title.

218. ཨ་མདོ་གསེར་ཁང་རྡོ་རྗེ་འཆང་གི་འཇིགས་བྱེད་བསྙེན་སྐོར་ (154). Concerning the recitation (japa) to Yamāntaka, by (Lama) Vajradhara of the Golden House (Temple ?) in Amdo. མཚམས་དཔེ་, book of 'retreat.' Geluk. Elsewhere in these lists, I have rendered བསྙེན་ by propitiation (so in Nos. 40, 41), but I am told that the term specially means propitiation by japa, and should here be so understood. See S. C. D.'s last example s.v. བསྙེན་པ་ in his dict. Orally, སྒྲུབ་པ་ was given as a synonym.

219. ཨེ་བླ་མའི་གསུང་འབུམ་ (38). Collected works of the Lama from E (a place in Southern Tibet, North of Bhutan).

VI. ADDENDA.

To II. I. d, p. 459.

Add as No. *11*:

W. Botting Hemsley, The flora of Tibet or High Asia, in the Journal of the Linnean Society, Vol. XXXV, (1902), No. 244, pp 124-265. On pp 259-265 there is a very complete botanical bibliography.

To II. II a, p. 460.

Add as No. *10a* the very important analysis of Tibetan Medical works in the Tanjur, by Dr. P Cordier, Introduction a l'étude des traités médicaux sanscrits inclus dans le Tanjur tibétain. In the B É F.O. for 1903, Vol. 3, pp. 604-629 and also reprinted separately.

On the same page a reference should be added to the following articles:

10b F. W Thomas. Deux Collections sanscrites et tibétaines de Sādhanas, Le Muséon. Nouvelle Série, Vol. IV (1903), pp. 1-42, also reprinted separately.

10c Th. de Stcherbatskoi, La littérature Yogācāra d'après Bouston, Le Muséon, Nouvelle Série, Vol. VI (1905), pp. 141-155 Also reprinted separately

Though not bibliographical in the sense of describing editions, the article should be mentioned because describing titles as given by a Tibetan authority.

As No. *11a* add: Sarat Chandra Vidyābhuṣana A History of Indian Logic This work, which has appeared this year or is about to appear, published by the University of Calcutta, contains copious references to the material on logic in the Tanjur. I have compiled an index to the Tibetan matter in the volume and for the convenience of those interested I have had a small number of copies of this index reprinted separately.

Under *11b* a reference may be made to the earlier and shorter work of the same Author on the same subject "History of the Mediæval School of Indian Logic," Calcutta University Studies, No. 1, Calcutta, 1909.

To V. No. 144 on p. 509.

The long delay in the printing of this article has had its advantage and profit. Not the least of these has been that I have been able to acquire in the meantime a printed copy of the booklet mentioned under No. 144 of the alphabetical list, so that I am now able to add a fuller account of it here. Its full title is ཆོས་སྡེ་ཆེན་པོ་དཔལ་ལྡན་འབྲས་སྤུངས་ཀྱི་པར་ཁང་ཆེན་པོའི་གསུང་པར་དཀར་ཆག་ (བཞུགས་སོ་), Systematic description of the book-blocks in the noble printing-house of the noble and glorious religious institution, called the "White Mass" The name འབྲས་སྤུངས་, nearly always literally translated as "Heap of Rice," does not mean this at all to the Tibetan. "Rice" means here "white like rice," as we would use "snow-white" or "snowy" alone. The expression ཆེན་པོ་, lit. great, in connection with names or titles often means noble, illustrious, "his honour," an epithet of respect. The marginal title is simply གསུང་པར་དཀར་ཆག་. The booklet consists of seven leaves This very important document contains a brief preamble of one page and then enumerates the titles of works or parts of works of which the blocks are preserved in the printing establishment of the Däpung monastery (Lhasa) with the exact number of blocks of each work, and an indication of the room where they are kept.

The following gives in brief the substance of the contents:

The preamble says that during the time of the fifth Dalai Lama an inventory was made of the blocks in the Däpung printing house. As afterwards many new blocks had been cut, therefore ' now " the thirteenth Dalai Lama in the 15th རབ་བྱུང་ (prabhava) cycle, in the Iron-Monkey (57th) year (that is in 1920, three years ago), has commanded a new list to be prepared. Then follows the long list ot bare titles, giving in each case the number of the blocks for each title, stored away in the rooms numbered from ཀ་ (1) to ད་ (11). In all 285 titles are given, of which the blocks number 40,807, which represents half that number of leaves. Of the titles given some do not indicate single works but collections.

34. Advances in our Knowledge of the Fauna of the Fresh and Brackish Waters of India, with a Bibliography for the years 1912-1922.

By N. ANNANDALE, D.Sc, F.A.S.B., *Director, Zoological Survey of India.* Bibliography compiled by CEDRIC DOVER, F.E.S.

Ten years ago I published in this Journal[1] a brief account of our knowledge of the freshwater fauna of the Indian Empire. Since then much has been done in both fresh and brackish water and it will, I think, be a useful task to take stock of our acquisitions in the last decade. This task I have undertaken with the aid of the bibliography prepared, mainly under my supervision, by Mr Cedric Dover. While admitting references to groups such as the reptiles and Batrachia omitted from my former paper, he has not included references to insects. This has been unnecessary owing to the publication of several comprehensive works Many papers have been written on aquatic entomology in the period under review, particularly on the Diptera Nemocera, on the Odonata and on the Hemiptera or Rhynchota; but references to the first of these groups are given in Mr Brunetti's "Catalogue" (*Rec. Ind. Mus.*, XVII, 1920) and in the first volume on the Diptera published by him in the "Fauna of British India" (1912) A more recent paper of exceptional interest is Mr. F. W. Edward's account of an aquatic Dipteron from Kashmir so peculiar as to constitute a new family of Nemocera. This insect, to which the name *Deuterophlebia mirabilis* has been given, is described in Vol. IX (p. 379) of the *Annals and Magazine of Natural History*, 1922.

Apart from the information contained in the later volumes on the Rhynchota by Mr. W. L. Distant in the "Fauna" series, the late Mr. C. A. Paiva's papers on the aquatic species of the Southern Shan States and the Garo hills in volumes XIV and XVI of the *Records of the Indian Museum* contain the most important additions.

Dr. F. F. Laidlaw and Major F. C. Frazer have published a number of valuable papers on the Indian dragonflies and their larvae in the same Journal from 1912 onwards and in that of the Bombay Natural History Society from 1915, while Dr. R. J. Tillyard's account of an extremely archaic larva of the same group from the Darjiling hills is one of the most important contributions to entomology that have appeared recently. It is published in *Rec. Ind Mus.*, XXII, 1921.

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[1] "Some Recent Advances in our Knowledge of the Freshwater Fauna of India." *Journ. As. Soc. Beng.* (n s.), VIII, pp. 39–52 (1912).

A glance through Mr Dover's bibliography will show that most of the recent work on the fresh- and brackish-water fauna of India has been undertaken and published in India, and a very large proportion in Calcutta. Ever since Buchanan's investigation of the fishes of the Ganges over a century ago Calcutta has been, with brief intervals, a centre of studies of the kind. The possibility of their existence in India has been denied in England, but *littera scripta manet.* The names and the papers of McClelland, Benson, Nevill, Stoliczka, Anderson, Wood-Mason, and Alcock are there to attest the succession and we of the present generation can only hope to be numbered with these men.

I do not propose to discuss in detail the additions made to our knowledge of purely taxonomic zoology. In this respect Mr. Dover's bibliography speaks for itself. I have, however, given a summary of the more important results of a general nature arising from investigations of a more comprehensive kind. Applied zoology is best left to those whose duty it is to apply the results obtained from pure zoological research and I have not attempted to discuss it Mr. Dover has, however, included in his bibliography references to all appropriate works available on fisheries and medical zoology published in the period under review In parasitology, however, he has included only those papers which deal with parasites that pass some part or the whole of their life-cycle in aquatic animals other than insects.

The decade has been prolific in reports on the fauna of particular localities and types of environment in India and neighbouring countries. Two quarto volumes, neither of which is yet complete, may be mentioned first. They are (*i*) the report on the fauna of the Chilka Lake that forms volume V of the *Memoirs of the Indian Museum,* and, (*ii*), volume VI of the *Memoirs of the Asiatic Society of Bengal,* in which are embodied the zoological results of a tour in the Far East (i.e. in Japan, China, Siam and Malaya) undertaken in the years 1915 to 1916

The report on the Fauna of the Chilka Lake is based mainly on investigations carried out in 1914 by Dr. S. W. Kemp and myself. It consists of papers by many specialists both on strictly zoological subjects and also on hydrography, an appreciation of which is so necessary for the proper study of aquatic faunas. Most of the animals of the Chilka Lake are of recent marine origin, but they are adapted physiologically to endure great and often sudden changes in the composition of the water in which they live. Many groups are represented in the fauna that were hitherto thought to be exclusively marine, and some species extremely common in the lake belong to groups unknown, though doubtless existing as rarities, in adjacent seas I may mention in particular the primitive sea-anemone *Edwardsia tinctrix*, the congeners of which are mainly found in northern regions but also occur in the extreme south. The direct effects of a lowering of the salinity, and, therefore, of the specific gravity, of the water on a medusa (*Acromitus rabanchatu*) common in the lake and also in the Bay of Bengal, have been observed, while much other bionomical information of a like nature has been obtained. The report when complete will be the first detailed account of the fauna of any tropical area of brackish water. We hope to finish it next year.

The chief object of my visit to the Far East in 1915 and 1916 was to obtain material for a comparison between the fauna of the Chilka Lake and of other bodies of water of low salinity in India on the one hand, and that of three lakes situated further East in Asia. These lakes were Lake Biwa on the Main Island of Japan, the Tai-Hu in the Kiangsu province of China and the Talé Sap in Peninsular Siam. The last of these resembles the Chilka Lake very closely in many respects, while the Tai-Hu is situated not far from the coast and has a large marine element in its fauna; but Lake Biwa is a typical alpine lake.

The volume in the *Memoirs of the Asiatic Society of Bengal*, although it does not deal directly with the Indian fauna, has, therefore, an important indirect connection with our present subject. Like that on the Chilka Lake it contains zoological papers by many specialists.

In a separate paper on the fauna of Lake Biwa, to be published shortly in the *Annotationes Zoologicae Japonenses*[1], I have compared the fauna of that lake with the fauna of several other inland lakes in India and other parts of Asia.

Another volume devoted primarily to an aquatic fauna living on and near the Indian frontiers is volume XVIII of the *Records of the Indian Museum*, which is concerned with the isolated basin of Seistan in the eastern part of the Persian desert and with certain districts of British Baluchistan. The investigations carried out in these countries by Dr. S. W. Kemp and myself in the winter of 1918–1919 have provided much interesting material for comparative study. Although Seistan is an inland country and has had no communication with the sea since very ancient times, its lake (the Hamun-i-Helmund) and watercourses have this much in common with the Chilka Lake, that very little of their water is quite fresh. Its salinity, however, is due to purely local causes and the salts it contains are not sea-salts. Its fauna includes no marine or maritime species and is interesting chiefly because, having been derived necessarily from the highlands of Afghanistan and Baluchistan, it is to a large extent a high-mountain fauna adapted to live in a comparatively low swampy depression This is noteworthy particularly among the fish, several species of which are identical with, or very closely related to. forms known otherwise from great altitudes in Central Asia. A distinct reduction in the size of the fins may be noted in certain species The fauna of sponges and polyzoa, on the other hand, is interesting on account of its Indian affinities, while the molluscs belong to what I have called elsewhere the "Afghan" type.

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[1] Now published in *Annot. Zool. Jap.*, X (1922).

Of normal inland lakes within the limits of the Indian Empire by far the most interesting as yet investigated is the Inlé Lake on the limestone plateau of the Southern Shan States. The fauna of this lake was collected by Dr. F. H. Gravely and myself in the early part of 1917. It proved so interesting in many respects that I paid the lake a second visit in the spring of 1922, accompanied by Dr. Sunder Lal Hora and Mr. H. Srinivasa Rao. The fauna is remarkably distinct, especially in fish and molluscs Many of the former are very small and brightly coloured, with large eyes and poorly developed tactile organs. These characters appear to be correlated with the exceptional clearness and limpidity of the water of the lake and this again is due to its peculiar chemical composition, in which salts of lime and magnesium are abundant. The molluscs, possibly[1] in correlation with the presence of these salts, have in some species remarkably sculptured shells and exhibit extraordinary plasticity and individual variability. It was chiefly to study these phenomena that I visited the lake for a second time. The results of the second tour are not yet worked out; those of the first are contained in *Rec. Ind. Mus.*, XIV (1918).

Other Indian lakes of which the fauna has been studied in the period under review are those of Kashmir and Kumaon in the Himalayas and of Manipur on the Burmese frontier of Assam. The lakes of Kumaon were visited some years ago by Dr. S. W. Kemp and have been investigated more recently by Dr. Baini Prashad and Dr. Sunder Lal Hora. Except as regards the sponges and polyzoa, which are extremely abundant but not otherwise remarkable, the fauna has no very great interest. The lakes are of comparatively recent origin, produced by landslips damming up valleys, and their molluscs and fish are not distinctive. Although some of the lakes are deep, there does not seem to be any specialized deep-water fauna.

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[1] A recent, detailed, chemical examination of the water and of the shells themselves, undertaken in the Indian Institute of Science at Bangalore, render this less probable than it formerly appeared.

See the papers on different groups in volumes VII and XXIV of the *Rec. Ind. Mus.*

The fauna of the lakes of Kashmir, although of no great importance in itself, is of considerable geographical interest, for it represents an outlying branch of the true Eurasian fauna of Europe and Central Asia. The lakes, belonging as they do to the Indus system, appear to have formed the only reservoir for this fauna in Indian territory. They were investigated recently by Dr. Baini Prashad and Mr. B. Chopra, whose results have not yet been completely worked out. They will be published later in the *Rec. Ind. Mus.*

The isolated valley of Manipur contains a lake of considerable but variable size which is in direct communication with the Chindwin, the main tributary of the Irrawadi. This lake in many respects resembles the Inlé Lake but has muddy water of much more normal chemical composition on account of the rocks through which its feeders flow being insoluble. Its fauna is by no means rich and its chief faunistic interest lies in the contrast it provides with the Inlé Lake. The fish have been described by Dr Hora, who accompanied me to Manipur in the early part of 1920, in *Rec. Ind. Mus.*, XXII (1921), while the molluscs have been discussed by Dr. Baini Prashad, Mr. Amin-ud-Din and myself in the same volume. In my introduction to our paper I have compared the fauna as a whole with that of the Inlé Lake. It differs mainly in not being at all highly specialized. The fish are few and are mostly bottom-haunting species, provided with well-developed tactile organs, as might be expected in a muddy, weed-choked swamp like the Loktak, as the lake is called. The molluscs are rather more remarkable but have no resemblance to those of the Inlé Lake.

It is easier to study the fauna of a lake in a comprehensive spirit than to investigate that of a river or stream. The former is as it were concentrated and can be collected in a comparatively short time, while the latter is always moving from place to place and in a short visit one can gain but an imperfect and often distorted view of its characteristic features. The fauna of running water, however, has not been entirely neglected in India in the last ten years. In a paper (*Rec. Ind. Mus.*, XVI.) on that of a small stream in the Bombay Presidency which has been visited at different times by Dr. F. H. Gravely, Prof. S. P. Agharkar and myself, I have attempted to describe the animal life in a type of stream very common at the base of hill-ranges in the plains of Peninsular India. The particular stream is a small tributary of the Kistna system. It happens to be the abode of the freshwater medusa *Limnocnida indica*, but otherwise has no very marked peculiarities. Apart from the medusa, its most interesting feature is perhaps to be found in its sponges. These, which are attached to rocks liable to desiccation, belong partly to the genus *Corvospongilla* and those that do so are remarkable for their almost stony hardness and for the fact that they produce two kinds of gemmules or resting-buds, one kind capable of floating and being carried away by the stream, the other firmly fixed to the rocks.

To turn from a small stream to a great river, something has also been done on the fauna of the Ganges. The only comprehensive paper yet published is Dr. Kemp's account of that of the Matlah River, which is now little more than a tidal creek running up the delta to the vicinity of Calcutta, but formerly drained large salt lakes which have now disappeared. Dr. Kemp has shown that the animals, particularly the fish and crustacea, of the lower reaches of this creek have a remarkable resemblance to those of the deep sea. In most species this resemblance is superficial and clearly produced by convergent evolution, but one fish, the Bombay Duck (*Harpodon nehereus*), is closely related to deep-sea forms. The main resemblances between the fauna and that of the deep sea lie in colour, degenerate eyes and the production of whip-like tactile organs of various kinds These Dr. Kemp correlates with low visibility, due to absence of light in the abysses and presence of suspended silt in the deltaic creek, and with an extremely soft oozy bottom in both types of environment.

The fauna of the Matlah River is, strictly speaking, marine or rather estuarine, but the presence of a marine element in the fauna of the Ganges itself far above tidal influence has long been known. I have discussed this element at length in a paper to be published shortly in the special volume of the Dutch *Bijdragen tot de Dierkunde* [1] to be issued in honour of the seventieth birthday of Prof Max Weber of Amsterdam. The two most interesting regions in tropical river-systems are, from the faunistic point of view, the mountain torrents and the deltaic effluents. In both much still remains to be done in India. So far as the mountain streams are concerned, several papers have been published recently on the fish and on the tadpoles These we owe chiefly to Dr. Hora, who has investigated the anatomy of the adhesive organs, etc. in a very thorough manner. In one paper, just issued in the *Rec. Ind. Mus*, Dr. Hora and I have discussed the "communal convergence" that exists between the larvae of so-called Ranae Formosae and the fish of the genus *Garra* or *Discognathus* and certain other genera found in mountain torrents.

In many of the papers cited in the bibliography the geographical distribution of the species, genera or families concerned is discussed at length The resemblance between the freshwater fauna of the Malabar zone and that of tropical Africa may now be regarded as well established, but it has been shown within the last few years that traces of the common element can be found much further East than western India. Recent investigations on the other hand, particularly of the molluscs, have demonstrated the general uniformity of the paludine fauna of the main area of Peninsular India and the Indo-Gangetic plain. This fauna, some part of which already existed in late cretaceous times, has become impoverished in more recent geological epochs and cannot now be compared in richness and diversity with that of the eastern parts of Burma. In that country the supposed Chinese element has been found, so far as aquatic animals are concerned, to be due largely to convergence.

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[1] Now published in *Bijdr. t. d. Dierk.*, Afl. 22 (1922).

The chief groups of animals in which taxonomic advances of a comprehensive kind have been made in the last ten years so far as the freshwater and brackish-water faunas of India are concerned, are the Chelonia, the Batrachia, the fish, the molluscs, the Decapod Crustacea, the Oligochaete worms and the cercariae of the parasitic trematodes

As I have already stated, I do not propose to discuss these advances at length, but I cannot conclude this brief paper without a reference to the admirable taxonomic work on the Decapod and Stomatopod Crustacea accomplished by my colleague Dr S. W. Kemp in Calcutta, on the Oligochaete worms carried out in Lahore by Lt -Col. J. Stephenson and on the cercariae by Major R. B. Seymour Sewell, partly in Calcutta and partly in the field in diverse parts of India I must also mention the work on the freshwater molluscs, in which Dr. Baini Prashad's anatomical investigation of the Unionidae plays so important a part. This work is of particular interest from an historical point of view in that it is largely a revival and revision of that undertaken more than a generation ago by the older malacologists of Calcutta and published to a large extent in the early volumes of this Journal. In it I have taken some share myself and must express my gratitude for the encouragement given me by the veteran naturalist and geographer Lt.-Col. H. H. Godwin-Austen, F.R.S , who was himself associated in India with Blanford and other naturalists, once active members of the Asiatic Society of Bengal, and is, indeed, now the only survivor of that brilliant band.

The Fresh and Brackish Water Fauna of the Indian Empire and Ceylon : A Bibliography for the years 1912–22.

A word of explanation as to the scope and arrangement of this bibliography seems necessary. Its main object is to give a list of all papers on the fresh and brackish water zoology (excepting insects) of the Indian Empire and Ceylon published in the last ten years, but to increase its utility I have tried to include the titles of papers dealing chiefly with material from outside India, but which have a more or less direct bearing on our subject. These have been marked with an asterisk. Some papers dealing with widely distributed animals occurring in India and Ceylon, but based on material from outside this region, have had for various reasons to be omitted. For example, the biochemical and physiological papers on the protozoan *Paramoecium caudatum* and its allies which have recently been published in Europe, chiefly in the *Archiv für Protistenkunde*, have not been included here. From the systematic point of view, however, it is hoped that this bibliography is fairly complete.

To economise in space papers by more than one author have only been listed under the name of the senior author, and for the same reason the names of the Records and Memoirs of the Indian Museum and the Journal and Proceedings (new series) and Memoirs of the Asiatic Society of Bengal have been abbreviated to *R I.M.*, *M.I.M.*, *J A.S.B.* and *M.A S.B.*

C. DOVER.

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35. Bivalve Molluscs injuring Brickwork in the Calcutta Docks.

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My attention was recently drawn by Mr. J. McGlashan, Chief Engineer to the Port of Calcutta, to the fact that injury had been done to the brickwork at the entrance to one of the dry docks by a small bivalve mollusc. With his kind assistance and with that of Dr. S. W. Kemp and Mr. G. H. Tipper, I was able to examine the damaged wall on January 7th. a considerable amount of water having been run out of the dock. The damage was not very serious and it was evident that the mollusc had been able to attack only those parts of the wall at which the blue glaze on the bricks had been worn away or abraded. Moreover, all the individuals discovered had died after penetrating to a depth of about half a brick, killed possibly either by some change in the salinity of the water, or more probably by the flowing into the docks of some chemical waste product. Conditions may, however, have been unfavourable for reproduction. Had the activities of the mollusc continued uninterrupted for a long period there can be no doubt that they would ultimately have destroyed the whole submerged surface of the wall wherever it was not glazed or the glaze had disappeared. They had been most active inside a large culvert but patches of the outer wall of the entrance had also been attacked, always below the habitual water-level. The brickwork is about thirty years old and showed no sign of more than one attack, which was probably carried out by a single generation of molluscs, or at most by one flourishing and a second more feeble generation.

Only one species was concerned in the actual damage, namely the Pholad *Martesia fluminalis* but other molluscs were beginning to accumulate in the holes made by it and some of these were still alive. One of the species (*Modiola striatula*) has already been reported as doing injury to brickwork in the Calcutta docks by insinuating itself into cracks and joints and there increasing in numbers and bulk. Were large masses of this mussel or any other living organism to establish themselves in the Pholad's holes they would undoubtedly aid in the further disintegration of the bricks by breaking down the thin partitions left between the different burrows.

Young of the *Martesia* had evidently been assisted in settling on the bricks and commencing their boring operations by an inequality of the surface produced by the falling out from the bricks of small pieces of cinder incorporated in their substance. The burrows were bottle-shaped and penetrated the brick to a depth of about 4 cm. In one, of which a vertical section was obtained, the entrance on the surface was only a little more than 1 mm. in diameter, but the diameter at the base was 17 mm. The diameter increased gradually from above downwards. The shell fitted rather tightly into the base of the burrow and the animal of course could not possibly have emerged. The burrows were closely aggregated and sometimes one penetrated another. The direction of some was straight into the brick, in others slanting.

M. fluminalis, which is common in the deltas of the Ganges and Irrawadi, usually bores in wood but was originally found in soft argillaceous sandstone.

A few systematic notes as to the species collected may be given.

Scaphula deltae Blanford.

1868. *Scaphula deltae*, Blanford, *Journ. As. Soc Bengal* XXXVI (2), p. 71, pl. xiv, figs. 7–10.

Several specimens, living and dead, were found attached by their byssus in empty burrows of *M. fluminalis* in the bricks, so deeply covered by a slimy dark green alga that their presence was not detected until it had dried up. The species, which is doubtfully distinct from *S. celox* Benson, is common in the lower reaches of both the Ganges and the Irrawadi and also occurs high up the Mahanadi at Sambalpur in the interior of Orissa.

Corbula gracilis Preston.

1907. *Corbula gracilis*, Preston, *Ann. Mag. Nat. Hist.* (7) XIX, p. 215, fig. 4.

1911. *Corbula chilkaensis*, id., *Rec. Ind. Mus.* VI, p. 39, fig. 2.

A single empty shell was found inside one of *Martesia fluminalis* in a brick. It is rather larger than the type-specimen and both in size and other characters seems exactly intermediate between that specimen and the type-specimen of the same author's *C. chilkaensis*, which must be regarded as synonomous with *C. gracilis*.

The species is very near my *C. mesopotamica*, but apart from slight differences in outline, has the hinge-teeth much less produced.

In the Gangetic delta molluscs of this genus frequently make their way into the burrows of Teredinidae in wood and also into the exhalent canals of the sponge *Spongilla alba*.

Martesia fluminalis Blanford.

1868. *Martesia fluminalis*, Blanford, *Journ. As. Soc. Bengal* XXXVI (2), p. 67, pl. XIV, figs. 1–3.

Specimens from the docks are much larger than Blanford's type-series and exhibit great individual variability in shape. Their surface is also very irregular and often much eroded, but I have no doubt as to the identity, the sculpture being closely similar wherever it can be compared. There are, moreover, two large shells in the old collection of the Indian Museum labelled as being from a dock-gate in the Kidderpore docks and these shells, which were probably burrowing in wood have the surface intact and are very regular in shape.

The largest specimen from brickwork is 28 mm. broad × 15 mm. high × 14.5 mm thick, but the proportion of breadth to height varies in different shells in the same series from about 1·5 mm. to a little over 2·5. That of height to thickness is much more constant. The difference lies mainly in the elongation of the siphonal region in some specimens and its brevity in others. The periostracum, where it has not perished. is very thick and of a dark brown colour.

Modiola striatula Hanley.

1916. *Modiola striatula*, Annandale & Kemp. *Mem. Ind. Mus.* V, p. 360, pl. XV, figs. 7–18; pl. XVI, fig. 2.

A single small living shell of straight elongate type and with the longitudinal striae well developed was found anchored by its byssus in an empty *Martesia* burrow.

36. Some Remarks on Mr. C. Stuart Baker's new volume on the Birds in the "Fauna of British Inda"

By HERBERT C. ROBINSON and C. BODEN KLOSS.

In July, 1922, under the authorship of Mr. E. C. Stuart Baker, was published the first volume of the second edition of the "Fauna of British India. Birds" originally by Mr. E. W. Oates and Dr. W. T. Blanford.

The format is very similar to that of the earlier work and the same text figures have been used : in addition Mr. Baker has contributed eight coloured plates, which are hardly up to modern standards. The new volume covers the first 343 pages of its predecessor but omits both the *Brachypteryginae* (with the exception of *Tesia* and *Oligura*) and the *Dicruridae*, which have other places in Baker's systematic arrangement. Apart from these changes there are a good many instances of minor shuffling, while the names of families, subfamilies, genera and species have undergone many changes. Several new races are described for the first time. We think the practice a bad one ; and most ornithologists will probably agree that it is desirable that descriptions of new forms should receive first publication in a zoological journal. In 466 pages 476 subspecies are dealt with. The plan for the new edition is to issue it in volumes which will follow each other at intervals of two years : it will thus be a considerable time before the work is completed.

In that Mr. Baker recognises subspecies and deals with them under trinomial titles, and also cites type localities—thus following the latest developments in systematic zoology—the present volume is an advance on the first edition. Unfortunately this cannot be said of it in its entirety.

The author's method leads him frequently into an *ex-cathedra* attitude and he would probably agree that, since his knowledge cannot be complete nor his judgment infallible, this method of dealing with the subject is unsatisfactory to other ornithologists who are unprepared to accept blindly the conclusions of a fellow-worker.

In this respect, and because (in spite of the claim made for it by the Editor) it lowers the standard set by the editor and authors of the first edition, we especially deplore the absence of a synonomy as we are unable to see whether the author has omitted certain races that have been described because he cannot accept them or because he is ignorant of them (as instances of this :—*Dryonastes propinquus* Salvad., Ann. Mus. Civ. Gen., 6. 1915, p. 6 : Tenasserim ; *Garrulax* *putkaicus* Reichenow, Journ Ornith. Leipzig, 61, 1913, p. 557: N. E. Assam). The compilation of a synonomy is both tedious and dull: it is unlikely that exhaustive research of the kind will be undertaken unless there is strong reason to do so and the fact that no synonomy must be shewn inevitably, we fear, makes for superficiality.

The reason given for the absence of lists of references is that it has been possible to devote the space they would have occupied to additional field-notes—in effect, notes on nidification. In a work with the claims and purposes of the present we could well have spared the latter for the former: and the paragraphs on nidification might have been issued in a small and inexpensive companion volume. The result is that the ornithologist who is not ready to accept without question Mr. Baker's treatment of Indian birds has to turn to the early edition for references previous to its publication and must rely upon his own researches in literature for a knowledge of later information. Except for a reference to the first publication of names used and to " Blanford and Oates " (*sic*) the student of this volume is left in the dark over ninety per cent of it: almost might he think that Indian Ornithology here makes its start: " *Pereant illi qui ante nos nostra dixerunt.*"

We feel that, failing a record of all literature dealing with a bird from the " Indian " point of view, one or two alternatives should have been adopted; either the synonomy of Oates and Blanford should have been continued from the stage where they left off and brought up to date, or we should have been given, at least, a list of all true synonyms—that is, references to all names under which the forms dealt with have been described in the belief that they were new and distinct.

It seems advisable to point out some of the errors that have been perpetrated before they become accepted. We have confined ourselves to a scrutiny—and that somewhat hurried—of such species, Malaysian and eastern Indo-Chinese, as we are specially interested in: others, more concerned with them than ourselves, may have remarks to make about the remaining forms. It is to be hoped that Mr. Baker will include a list of corrections in the next volume, and that his succeeding work will not be disfigured by the inaccuracies, as we consider them, betrayed by the present one.

Naturally, Mr. Baker has not yet attained finality in the matter of nomenclature: and we fear that the younger generation cannot congratulate themselves that they are, from this book, " learning names which with few exceptions, will be permanent " (p. 3): a little help in this good cause will, however, be found below, where also will be found substantiation for our statements.

While these remarks partake of that form of criticism which is the easiest, i.e., destructive criticism—because in this instance it is also the most useful—we fully realise with how much energy and industry Mr. Baker has applied himself to this work. To have produced such a volume in his leisure hours is most praiseworthy: it is really a task for an author who could devote his whole time to it without distractions. In spite of its faults—to some extent unavoidable—the new edition is most welcome and should do much to encourage the practical study of ornithology in the East: especially if Mr. Baker will be guided by the axiom "*Post malam segetem serendum est*" and include a list of addenda and corrigenda in the second volume.

p. 45. *Cissa chinensis.* The type locality is given as China: the species does not occur there and we select Southern Siam, whence specimens may well have reached Canton as cage birds.

pp. 52, 53. *Dendrocitta sinensis.* Oberholser pointed out in 1920 (Proc. Biol. Soc. Washington, 33, p. 83) that *Corvus sinensis* Latham, is preoccupied by *Corvus sinensis* Gmelin, and proposed, in the absence of any other name, *Dendrocitta celadina.* The two sub-species *himalayensis* and *assimilis* must therefore stand as forms of **Dendrocitta celadina.**

p. 141. Add to the distribution of *Dryonastes chinensis leucogenys* Tenasserim; Nwalabo (Hopwood) and S.W. Siam (Gairdner). *Dryonastes chinensis germaini* is not a new species of ours, but was described by Oustalet in 1890!

pp. 146–8. *Garrulax leucolophus.* The distributions given for the sub-species *belangeri* and *diardi* are obviously incorrect and cross each other. Both forms do not occur in Annam where the latter only is found.

pp. 150, 1. Tenasserim is omitted from the distribution of *Garrulax pectoralis*: the race occurring there is probably *G. p. meridionalis* Robinson and Kloss, (Bull. B. O. C. XL, 1919. p. 11: Hat Sanuk near Koh Lak, S. W. Siam).

p. 163. The key to the sub-species of *Trochalopterum erythrocephalum* is incorrect. *T. e. woodi,* described on p. 166 as having the back unmarked with black, is placed in the section "Back and breast with large black round spots".

p. 167. *T. melanostigma* ranges as far south in Tenasserim as Nwalabo (vide Hopwood).

pp. 193–4 *Turdoides griseus griseus* and *T. g. striatus.* Oberholser has pointed out that *Turdus griseus* Gm., is preoccupied by *Turdus griseus* Bodd., and since there is no synonym of the former he has proposed *Turdoides polioplocamus* nom. nov. These two birds must therefore stand as :—

Turdoides polioplocamus polioplocamus.

Turdoides polioplocamus Oberholser. (Proc. Biol Soc. Washington 33, 1920, p. 84: (Coromandel Coast.), and **Turdoides polioplocamus striatus.**

p. 209. In the southern part of Tenasserim *Pomatorhinus olivaceus olivaceus* is replaced by *P. o. fastidiosus* Hartert, (Bull. B.O C. XXXVI, 1916, p. 81): Trang, Peninsular Siam (syn. *siamensis* Baker). *Nuchalis* and *olivaceus* and the forms placed with them should probably all stand as sub-species of *schisticeps.*

p. 246. *Pellorneum* (or *Drymocataphus*) *nigricapitatum* is a subspecies of *capistratus.*

p. 254, 5. The Malayan form of *Turdinulus epilepidotus* is not *davisoni*: but *granti* Richmond (Proc. U. S. Nat. Mus 1900, p. 320: Trang, Peninsular Siam). The latter possibly occurs in Southern Tenasserim. Eggs from "near Perak," therefore, are not those of *T. e. davisoni.*

p. 257. *Horizillas magna magna.* There is only one race and trinomial momenclature is uncalled for.

p. 258, 9. *Erythrocichla bicolor* certainly occurs in Borneo but as the sub-species *E. b. whiteheadi* Hartert. The name should therefore stand as **Erythrocichla bicolor bicolor.**

p 259. The continental form of *Aethostoma rostrata* must stand as **Aethostoma rostratum rostratum** since in Borneo there is a sub-species *A. r. witmeri*, Sharpe.

For the type locality "Malaya" is a very vague term and Singapore should be substituted.

p. 260. The generic name *Turdinus* is stated to be preoccupied and *Malacoçincla* must take its place. The existence of *Turdinus* (type *Turdinus macrodactylus* Blyth) has no effect on *Malacocincla* the species of which are quite distinct from those contained in *Turdinus.* The genus *Malacocincla* was proposed by Blyth in 1845, not by Büttikofer in 1895.

Malacocincla sepiaria abbotti should stand as **Malacocincla abbotti abbotti** for those who regard *M. a. olivacea* (Strickland: Malacca) of the Malay States as distinct, while a Bornean bird has also been ranked as a sub-species, i.e., *M. buttikoferi* Finsch. *M. abbotti* Blyth, and *M. sepiaria* (Horsf.) are two perfectly distinct species though they bear a superficial resemblance to each other, and their ranges overlap.

p. 262. *Thringorhina guttata* should stand as **Thringorhina striolata guttata.**

p. 267. *Stachyris chrysaea chrysops* has type locality in Peninsular Siam, Lat. 7°–8° N. It is difficult therefore to believe that it also occurs in Assam when an intermediate locality, Karennee, Shan States and E. Central Burma, is occupied by *S. c. assimilis* pp. 271, 2. *Cyanoderma erythroptera erythroptera.* Type locality not "Malay" but Singapore. This race is not found in Borneo.

pp. 272–5. *Mixornis rubricapilla rubricapilla* extends south through Tenasserim to about Tavoy (cf. Hume, Stray Feathers, VI, 1877, p. 266) *M. r pileata* (type locality Malay Peninsula, not Malay (*sic*): restricted to Malacca) ranges north to about Lat. 6°. The area between these two is occupied by *M. r. connectens* (type locality, Peninsular Siam, in the latitude of Victoria Point) which ranges eastward through South Siam to Cochin China and South Annam and meets still another form in Central Siam. Whether this last should be known as *M. r. sulphurea* (Rippon) or *M. r. minor* Gyldenstolpe, is a vexed question. Though Mr. Baker has examined such a large series of *Mixornis* it is obvious from his conclusions that he has not seen sufficient relevant material.

p. 274. For *Mixornis rubricapilla pileata* read **Mixornis rubricapilla connectens** (*Mixornis rubricapilla connectens* Kloss, Ibis, 1918, p. 206: Peninsular Siam, Lat. 10°).

p 280. *Alcippe phaeocephala magnirostris. Alcippe magnirostris* Walden, is preoccupied by *Alcippe magnirostris* Moore, 1854 (*Turdinus* or *Horizillas magnirostris*) and the Karennee Quaker-Thrush may therefore be known as **Alcippe phæocephala karenni** nom. nov.

p. 325. Delete from the distribution of *Erpornis xantholeuca xantholeuca,* the words "Siam and the N Malay Peninsula" and add "except Tenasserim."

p. 326. Add

(350a) **Erpornis xantholeuca interposita**

Herpornis xantholeuca interposita. Hartert, Bull. Brit Orn. Club, XXXVIII, 1917, p. 20 (Perak, South Malay Peninsula).

Like *E. x. xantholeuca* but with larger bill and wing, etc. Distribution:—Thoungyeen valley southwards through the Malay Peninsula

p. 333. *Pteruthius aeralatus* is not a distinct species but a race of *Pteruthius flaviscapis* (Temm., Pl. Col. No. 589, fig. I) of Java: it should therefore stand as **Pteruthius flaviscapis aeralatus.**

p 342. *Fringilla multicolor.* Gm., based on the "Green-rumped Finch" of Latham from Ceylon (Syn. II, pt. 1, 1783, p. 20) has page priority over *Motacilla zeylanica.* Gm., based on the "Ceylon Blackcap" of Brown (III. p. 36, t. 15) and the Ceylon Iora must be known as

Aegithina tiphia multicolor.

Fringilla multicolor. Gmelin, Syst. Nat. I, 1788, p. 924 (Ceylon).

See also Hume. Stray Feathers, V, 1877, p. 432

p. 351. The size given for the wing of *Chloropsis viridis zosterops* is much too small: it should read [illegible]7-105 mm. These are the extremes of a topo-typical series, while birds from the Pakohan and other parts of Peninsular Siam measure 92–104 mm. The type locality is not Tenasserim, but Sumatra. Delete Borneo from the distribution: the bird occurring there is *C. v. viriditectus* Hartert.

p. 353. *Chloropsis cyanopogon* should stand as

Chloropsis cyanopogon septentrionalis.

Chloropsis cyanopogon septentrionalis, **Robinson and Kloss**, Journ. Nat. Hist. Soc. Siam, III, 1918, p. 107 (Ghirbi, Peninsular Siam, Lat. 8° N).

Chloropsis cyanopogon Oates (Fauna Brit. Ind., Birds, I, p. 239). Description:—As given by Oates and Baker. Differs from the typical Sumatran bird in having a clearly defined, though narrow, line dividing the black of the throat from the green of the breast. The forehead also is distinctly yellower. Measurements:—Wing ♂ ♂ 73–81 mm; ♀ ♀ 70–75 mm. Distribution:—The Malay Peninsula northwards from Kedah to S. Tenasserim.

p. 354. *Mesia argentauris argentauris.* Add the Malay Peninsula to the distribution; and for "*M. a. cunhacei* Kloss" read "*M. a cunhaci* Robinson and Kloss".

p 359–427. In a work purporting to speak with some claims to finality the treatment of the Bulbuls seems to be very superficial and faulty.

p. 362. It was needless to designate a type locality for *Criniger tephrogenys* as in 1902 Hartert selected "Malacca" (Nov. Zool. IX, 1902, p. 558). Overlooking, or more probably not knowing Hartert's work, Mr. Baker has fallen into the same error as Oates (p. 256) under a different nomenclature. Two Malayan White-throated Bulbuls occur in Tenasserim; *Criniger tephrogenys* and *Criniger ochraceus* Moore. Under the name *Criniger gutturalis* (S. Müll.) a Bornean bird, Oates included both or omitted one: Baker has done the same under *C. t. tephrogenys* though his description seems to apply to *C ochraceus*. The former species is of brighter colouration and smaller size; but we need not elaborate here as Hartert (*t.c.* pp. 558–560) has fully described both forms, and Hume and Davison in their composite *Criniger ochraceus*, of birds from Southern Tenasserim, also indicate the differences though they fail to recognise them (Stray Feathers, VI, 1877, pp. 301,515). New keys to *Criniger* are required: *C. t. tephrogenys* should be re-written and the nomenclature of it and the races reconsidered. There should be added also:

Criniger ochraceus ochraceus.

Criniger ochraceus Moore, in Horsfield and Moore. (Cat Birds Mus. E. Ind. I, 1854, p. 252, Tenasserim).

p. 365. The wing measurements of 100–115 mm. were given by Oustalet for *Criniger henrici* not for *C. pallida.*

p. 368. *Alophoixus phaeocephalus* should stand as **Alophoixus phaeocephalus phaeocephalus** as there is a Bornean race *Alophoixus phæocephalus diardi* (Finsch). Delete Java from the distribution.

p. 3 4–379. The genus *Hemixus* must be replaced by **Ixos** Temminck, 1825. (Type *Ixos virescens* Temm., Pl Col., No. 382, fig. I, livr. 64 : Java.) Oberholser has shown (Proc. Acad. Nat. Sci. Philadelphia, 1899, p. 212) that the genus is properly characterised and cannot be disregarded as was done by Sharpe (Cat. Birds Brit. Mus. VI, pp. 120,121).

p.379. The statement regarding the genus *Alcurus* is incorrect. It contains not only *A. striatus*, but also *A. leucogrammicus* (S. Müll.) of Sumatra.

p. 381. Robinson and Kloss have never expressed any joint opinion on forms of *Molplastes.* Mr. Baker is probably referring to Robinson's Ms. notes in the Natural History Museum.

p. 382. *Molplastes chrysorrhoides klossi* is not of Robinson, but of Gyldenstolpe ; and the latter has already corrected (in Bull. B. O. C. XLII, 1921) Mr. Baker s own and original error.

p. 386. *Molplastes haemorrhous nigripileus.* No description is given.

p. 392. *Genus Xanthixus.* For Kloss read Robinson and Kloss.

Xanthixus flavescens. On this species see the note at the end of this review.

p 396, 7. To the distribution of *Otocompsa emeria peguensis* should be added the Malay Peninsula. No type or typical locality are given for this new subspecies.

p. 402. *Trachycomus ochrocephalus* must stand as :—

Trachycomus zeylanicus.

Sturnus zeylanicus. Gmelin, Syst. Nat. I, 1788, p. 804 (Java).

Sturnus zeylanicus, Gm. (*l.c.*) is based on the Ceylonese "Starling" of Latham (Syn. II, pt. 1, 1783, p. II) and has page priority over *Turdus ochrocephalus.* Gm. (*t.c.* p. 821) based on the "Yellow-crowned Thrush" of Brown (III, p. 50, t. 22).

p 404. In our opinion *Hypsipetes malaccensis* Blyth is better included in *Ixos* (*Hemixus*) than in *Iole.*

p. 407. *Iole olivacea cinnamomeoventris* ranges southwards through the Malay Peninsula to Lat. 7°–8° N.

p. 409. The type of the genus *Rubigula* Blyth is *Turdus dispar* Horsf., which is certainly congeneric, and even conspecific, with *Brachypus gularis* Gould. Since Baker has placed *gularis* in the genus *Pycnonotus* (p. 415) it is illogical of him to retain *Rubigula*, and out of the question to do so merely for "bulbuls with squamated plumage" when the type does not possess this character. The type of one genus cannot be transferred to another and the first still retained. In our opinion *Rubigula* is a valid genus containing *dispar* (Type), *gularis* and probably *squamata.*

p. 415. *Pycnonotus gularis* should stand as *Rubigula dispar gularis*.

p. 418–421. *Pycnonotus plumosus*. The treatment of the races under this heading is entirely wrong. In the first place *P blanfordi* and *P. robinsoni* are not allied to *P. plumosus* in the specific sense; but to each other. *P. plumosus* is a Malayasian species extending up the Malay Peninsula into Tenasserim; *P. blanfordi* and its subspecies *P. robinsoni* is an Indo-Chinese species extending southwards down the Malay Peninsula to Patani (Lat. 6° 30′ N): there is thus a considerable overlap between the two.

P. p. plumosus is rightly given trinomially since subspecies exist in the Malay Archipelago. *P. p. blanfordi* should stand as **Pycnonotus blanfordi blanfordi** and be followed by **Pycnonotus blanfordi robinsoni**. The distribution of the last requires correction: it certainly occurs at Bangkok and no doubt at Krabin which is a town fifty miles to the east of that place, and at Ayuthia also near Bangkok; but since *P. b. blanfordi* occurs in South Annam the presence of the other race there is scarcely possible. Few may realise that Nhatrang (sandwiched between two Siamese localities) is a place in that region. *P. plumosus* is a much darker bird than *P. blanfordi*, especially on the abdomen and under tail coverts; its upper side, particularly the wings and tail, is strongly suffused with olive green; and the ear coverts are less silvery. The difference between *P. b. blanfordi* and *P. b. robinsoni* is very slight: the ear coverts of the latter seems a little less silvery and the abdomen and under tail coverts a little yellower. In the case of *P. plumosus* and *P. robinsoni* Mr. Baker has violated his own standard for subspecies (p. 1) for in a zone of 300 miles in the Malay Peninsula where both occur they are quite constant and there is absolutely no inter-gradation. Their alliance is only that of "representative species".

p. 421. *Pycnonotus simplex simplex* must stand as

Pycnonotus brunneus brunneus.

Pycnonotus brunneus Blyth, Journ. Asiat. Soc. Bengal, XIV, 1845, p. 568 (Malacca).

Pycnonotus simplex Oates, Fauna Brit. Ind. Birds, I, p. 292. The distribution of the sub species is Malay Peninsula, south of Mergui, and Sumatra.

Though rightly called " Moore's Olive Bulbul " by Oates and Baker the systematic name they used belongs to a Malaysian species which does not enter British India.

p. 422. *Pycnonotus erythropthalmos erythropthalmos.* The distribution of this form is omitted : it ranges south through the Malay Peninsula from the extreme south of Tenasserim. In a foot-note it is stated that *P. salvadorii* is the name of the Sumatran race: this is incorrect. Sharpe based it on a series of five Bornean birds as may be seen by a reference to the Cat. Birds Brit. Mus. VI, p. 155. It is true that after these an immature skin from Sumatra is mentioned but this cannot possibly be regarded as the type : further, Borneo has already been designated. Sumatran birds have been named *P. e. cyanochrus* by Oberholser.

p. 422. The generic name *Microtarsus* must be changed to *Brachypodius* Blyth (Type *Lanius melanocephalus* Gm..) now to be known as *Brachypodius atriceps* Temm. The type of *Microtarsus* Eyton, is *M. melanoleucus* Eyton, and it is incorrect to characterise *Microtarsus* as having barred rump feathers and a glossy head as *M. melanoleucus* possesses neither feature. The genus is a Malayasian one not entering British India and seems sufficiently distinct on account of its shorter tail coverts and the proportions of the culmen and tarsus : in *Brachypodius* the tail coverts are abnormally lengthened while the difference in length between culmen and tarsus is much less.

p. 423. The birds placed under *Microtarsus melanocephalus melanocephalus* represent two forms and should stand in future as

439. Brachypodius atriceps major.

Brachypodius atriceps major Robinson and Kloss, Journ. Fed. Malay States Mus. XI, p. 55, 1923 (Cachar).

Micropus melanocephalus Oates and Blanf., I, p. 294 (part.)

Description, etc., as given under *M. m. melanocephalus* by Baker · but distribution confined to British India and Siam north of the Isthmus of Kra.

439a. Brachypodius atriceps atriceps.

Turdus atriceps, Temminck, Pl. Col. No. 147, 1822 (Java).

Micropus melanocephalus, Oates and Blanf., I, p. 294 (part)

Like *B. a. major* but smaller: wings 75–81 mm. Distribution :—Tenasserim ; in the Malay Peninsula southwards ; Sumatra, Java, Borneo and the Philippines.

Both forms occur at the Pakchan where a series has been obtained with wings measuring 78–86 mm. Three examples from Koh Lak, S. W. Siam have wings of 79 mm. and it is therefore probable that the true range of *B. a. major* does not extend southwards much beyond Tavoy.

With regard to the specific name Oberholser has pointed out (Proc. U. S. Nat. Mus. 52, 1917, p. 193 that *Lanius melanocephalus* Gm (Syst. Nat. I, 1788, p. 309) is preoccupied by *Lanius melanocephalus* Gm. *t.c.* p. 301, and that the next available name is *Turdus atriceps* Temm. Pl. Col. No. 147, 1822 Java and Sumatra.

The following alterations are necessitated :—

p 425. *Microtarsus melanocephalus fusciflavescens* to **Brachypodius atriceps fusciflavescens**.
Microtarsus poiocephalus to **Brachypodius poiocephalus**.
p. 426. *Microtarsus cinereoventris* to **Brachypodius cinereoventris**.
p. 457. In *Pnoepyga* the sexes are said to differ : this may be the case in the Indian forms but not for the genus as a whole. In Malayasian birds, at any rate, it is impossible to constantly separate males from females (*cf.* Journ. Fed. Malay States Mus. VIII, pt 2, 1918, p. 204).

NOTE ON BLYTH'S BULBUL (*Xanthixus flavescens*).

By C. Boden Kloss

Some time ago Mr. Stuart Baker split *Xanthixus flavescens* Blyth, into two forms (Bull. Brit. Orn. Club, XXXVIII, 1917, p 16) ; but when working out my Annam collection a couple of years later Mr. H. C. Robinson and I had to deal with the species and finding that we could not accept Mr. Baker's ideas gave our reasons for not following him (Ibis, 1919, p. 567). In the new edition of the "Fauna of British India, Birds" (Vol. I, 1922, p. 392) Mr. Baker retains his own views and condemns ours though we had the advantage of him in that we had examined the two co-types and he had not seen them.

These types, of course, are the key to the whole matter and are again before me : they were collected by Phayre in Arakan and because Baker had specimens from Arakan which he found similar to birds from Assam he concluded that the latter were typical and named sub-specifically the birds inhabiting Northern Burma, the Shan States Karenne and North Tenasserim which differed from North-Western ones. No doubt specimens from North Arakan, in the neighbourhood of the Chin Hills, are the same as Assamese examples; but Arakan extends over some five degrees of latitude and a considerable amount of variation may occur in such an area. The birds collected by Phayre are very distinct from Assam birds and it is practically certain they came from South Arakan, in all probability from the hills between Sandoway and Prome which I select as the type locality of *X. f. flavescens.* Allowing for age they seem to differ in no respect from brightly-coloured specimens from the South Shan States and North Burma (eight examples). All these therefore, belong to the typical form and I believe it is that form which Mr. Baker has named *vivida.*

When we described *Xanthixus flavescens sordidus* from South Annam no material from Assam was available, but I have now four skins from Hungrum, N. Cachar and one from Manipur. All these differ from *X. f. flavescens* in being slightly less greenish above perhaps, and much less yellow below, the yellow except of the median lower abdomen, vent and tail-coverts being a slight streaky wash rather than a solid colour: they are paler, less deep olive (Ridgway) above and more yellow-washed, less deep greyish olive (Ridgway) below than *X. f. sordidus.* I propose for them the name

Xanthixus flavescens pallens subsp. nov.

Type. Male collected by E. C. Stuart Baker at Hungrum, North Cachar on 6th February 1895. Indian Museum No. 22956.

The three forms ot the species therefore are :—

i. *X. f. pallens* Kloss (syn. *X. f. flavescens* Baker, *nec* Blyth) North-Western form. Assam, Manipur,[1] Chin Hills, N. Arakan.

ii. *X. f. flavescens* (Blyth) (syn *X f. vivida* Baker) Central form. North Burma. Shan States, Karenne, N. Tenasserim,[2] South Arakan (type locality).

iii *X. f. sordidus* Robinson and Kloss (syn. *X. f. vividus* Baker, *fide* Baker). South-Eastern form. South Annam.

The material I have examined belongs to the Zoological Survey of India and I am indebted to Dr. N. Annandale for the opportunity of again seeing it.

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[1] The single Manipur specimen examined is yellower below than the Cachar series and is tending towards the typical race.

[2] Not known from the Malay Peninsula, much less the Malay States, as stated by Baker.

37. Observations on the Bat-Flowers of the Mohwa (*Bassia latifolia*).

By MAUDE L. CLEGHORN, F.L.S., F.Z.S., F.E.S.

As recent books on Indian Botany have not touched on the rather unique floral mechanism of the Mohwa these notes and sketches made in March and April 1914, have been put together for publication, as they may be of interest.

The swarms of bats at dusk visiting the tree when in flower attracted notice. Interest was also aroused to make closer observations because the bats appeared to be doing a great deal of damage; for instead of eating the fruit only, which is usually the case, they were devouring flowers instead.

The Mohwa tree is leafless when it starts coming into flower and the flowers have a strong unpleasant odour resembling that of bats. (It was not determined at the time whether the unpleasant scent was natural to the flower or comes from the numerous bats visiting them.) The drooping flowers which are about two to three inches long are borne in dense clusters, near the ends of the rather horizontally placed twigs, just below the tuft of young leaves. The flower and pedicel are tawny and tomentose. The corollas of the older flowers are cream-coloured and fleshy.

The calyx consists of four coriaceous tawny-coloured sepals about half an inch long. The corolla in the first stage of flowering is not fleshy and remains almost completely covered by the sepals with just the six or eight pointed lobes of the corolla only protruding and closely twisted round the style (Fig. 8). *It does not open like the corollas of other flowers.* In the second stage the corolla is fleshy and enlarged to more than twice its previous size and it still remains closed. There are about twenty-four stamens arranged in three series within the corolla tube. The anthers are subsessile, lanceolate and hairy at the back. They dehisce longitudinally to shed the pollen when the corolla is in the first stage and not fleshy and completely closed except for a few pore-like openings. The gynaecium consists of eight carpels forming a superior ovary and a linear style about one and a half inches long which protrudes from the corolla. The stigma is minute and terminal. The ovary is eight-celled with one ovule in each cell.

Each cluster consists of flowers of varying age. The very young buds are erect; as they grow older they assume the horizontal position and then the drooping when they reach the flowering stage. The sketches in Plate 1, figs. 1 and 2, were made from bunches actually growing on the tree and observed through field glasses. In all the bunches high up on the tree, examined through the glasses, it was found that only those buds which hang down have the styles protruding. Fig. 9 shows the longitudinal section of a flower in the first stage when the anthers are ripe. In this stage when lightly tapped at night a shower of pollen is given off. In Fig. 8*a*, a flower is seen with the tip of a sepal turned back to show the opening through which the pollen is shed. There are two other openings just under the tips of the opposite sepals. When the flower is touched or shaken the pollen is shed through the tip of the corolla tube too. The style was found to be sticky in all the flowers except the oldest and youngest.

A day or two after the pollen is shed the fleshy part of the corolla thickens. Fig. 11 gives a sketch of the flower in the second stage. Fig. 10 gives a section of the same showing the much enlarged and fleshy corolla. In this the second stage the corolla becomes much enlarged and quite fruit-like in its edibility, but *the stamens which are situated on the corolla tube have shed all their pollen before the second stage is reached, otherwise the anthers containing the pollen would be devoured along with the fleshy corollas.* As the corolla enlarges the style also grows and is found to be about half an inch longer than it was in the first stage. In this stage the stigma is mature and still sticky.

The early stage of the flower is quite bud-like and it could easily be mistaken for a bud as it does not even open. The anthers, however, shed their pollen through the minute openings at the base of the corolla lobes and through the pore-like opening at the tip of the corolla tube where it is wrapped round the long style (figs 8 and 9). The whole corolla when quite ripe comes off easily without damaging the style. Figs. 18 to 31, give sketches of flowers of varying age all taken from a single cluster. There were fourteen flowers in all and none were found to be damaged by bats.

Pollination is effected by bats while eating the fleshy corolla of the older flowers which have shed their pollen. The bats may be seen hanging upside down scrambling about hooking their half-open wings on to the flower-bearing twigs. In searching for the fleshy corollas of the older flowers they wrap their wings round the whole bunch and while doing so their wings may be compared to inverted umbrellas held close under the bunch, forming a ready receptacle for the pollen which is shed by the movements of the bats among the flowers. Cross-pollination appears to take place at this stage. The bats get the under surface of their wings powdered with the pollen from *the younger flowers* which are not fleshy whilst eating the fleshy corollas of the older flowers and the sticky stigmas of the older flowers rub against the pollen dusted inner surface of the bats' wings and get smeared with the pollen.

Most pendulous flowers have the loose pollen mechanism and *the anthers open by pores to shed the powdery pollen*, but in the pendulous flowers of the Mohwa *the anthers open laterally in longitudinal slits to shed the pollen into the cavity formed by the unopened corolla and the pollen is shed through the minute pore-like openings of the corolla instead.* The mechanism in the Mohwa somewhat resembles that of the common English Heath and also that of the Bruyère of the south of France in having pendulous flowers with loose pollen mechanism, but in these the anthers open by pores. The Mohwa also resembles that of the heather (*Calluna vulgaris*) in the rapid growth of the flower in the second stage. Regarding this growth Müller in his "Fertilisation of Flowers" states—"The style, which even in the bud overtops the stamens, grows very markedly after the flower opens as the flower itself does. As a rule, it attains its full length only after the anthers have completely shed their pollen, at which time the four-lobed stigma reaches its full development, but the stigma, even when the flower first opens, is capable of causing pollen-grains to adhere to it, and is not rarelv found dusted with pollen at that period."

The floral mechanism of the Mohwa appears to be of a rather extraordinary type and is also quite perfected in its own line Perhaps it should be mentioned that two recent books on Indian Botany, "A Manual of Elementary Botany for India" by Achain, and Basu's "Indian Medicinal Plants" have both given illustrations of the Mohwa flower "open", and have not mentioned in the text that the flower *never* opens.

A very accurate description, however, was given of the Mohwa tree as far back as 1785 by Hamilton in the first volume of "Asiatic Researches." In this he observes that "the flowers are of a nature very extraordinary, differing essentially from those of any other plant with which I am acquainted, as they have not, in any respect the usual appearance of such but rather resemble *berries*, and I, like many others, had long conceived them to be the *fruit* of the *Mahwah;* the tree drops its leaves in the month of February, and early in March these flowers begin to come out in clusters of thirty, forty or fifty, from the extremity of every small branchi; and from this period till the later end of April, as the flowers come to maturity (for they never open or expand) they continue falling off, with their antherae in the mornings, a little after sun-rise when they are gathered."

The type of floral mechanism found in the Môhwa in which a large portion of the actual flower is edible is a rather costly and uncertain one (although it has been wonderfully perfected in the Mohwa) and on this account appears to be very rare among plants. The only other plant with this type of mechanism, recorded so far, is *Fraycinclea,* a pandanus-like plant of Java, which is pollinated by bats while visiting the flowers for the edible bracts.

The flower of the Mohwa is of a high type and it also shows a further advance in its floral mechanism for it ensures cross-pollination by an ingenious and fairly simple method *with the flower actually remaining closed.* This type of mechanism has probably been derived comparatively recently from open flowers, as open flowers are found in all the other genera studied, belonging to the same Natural Order.

EXPLANATION OF PLATES.

Plate I.

The figures illustrating this note are selected from a number of sketches and drawings taken from living specimens either on the tree or immediately after being collected.

Few-flowered clusters had to be chosen and not the more typical many-flowered and densely crowded bunches as it was easier to follow the growth of the flower from day to day while still growing on the tree in the less crowded bunches.

The time at which the drawing of the flower in the various stages was made and other points of interest are noted in the following descriptions :—

FIG. 1.—Rough sketch made from bunch actually growing on the tree, and observed through field-glasses, showing young buds as seen on the morning of the 14th March.

FIG. 2.—Rough sketch of the same bunch on the morning of the 16th March, which shows the buds taking up the drooping position but with no styles projecting.

FIG. 3.—Sketch of the same bunch in Figs. 1 and 2, drawn on the morning of the 19th March. It shows the buds more pendant, and in two or three of the buds the styles appeared to be protruding slightly as far as could be made out with the glasses.

FIG 4.—Rough sketch of two bunches on the tree with buds older than those shown in Figs. 1, 2, and 3. Sketched on the morning of the 12th March. Three buds on the right bunch had styles protruding. On the left bunch one of the flowers was beginning to "ripen." On the 13th March two more flowers on the left bunch were becoming fleshy.

FIG. 5.—The same two bunches as shown in Fig. 4, but sketched on the 14th March. The left bunch had four flowers with ripe corollas while the right bunch had two. On the 15th March only one ripe flower was left on the right bunch. On the 19th March two of the younger buds of the bunch on the right had become fleshy and had styles protruding.

FIG. 6.—Sketch of two buds on a flowering branch as they appeared on the 2nd April.

FIG. 7.—The same buds sketched on the 5th April. But

B which was of the same age as *A* when cut on the 2nd April was shedding pollen on the evening of the 5th April. The *corolla at this stage is almost completely covered by the sepals.*

Fig. 8.—Bud-like flower in first stage sketched on the evening of the 5th April. When lightly tapped, pollen was shed through the pore-like openings and when the style was touched through the tip of the corolla tube.

Fig. 8*a*.—Slightly enlarged drawing of flower in the first stage with the tip of one of the sepals turned back to show the opening through which the pollen is shed. There were two other openings just under the tip of the opposite sepals but they were not so large.

Plate II.

Fig. 9 —Section of flower in the first stage. At this stage the anthers are ripe and the stigma sticky and when tapped or shaken at night it produces a shower of pollen. Sketched at 2 a.m. on the 29th March.

Fig. 10.—Section of flower in second stage with much enlarged fleshy corolla, and pollen shed. Natural size.

Fig. 11. —Sketch of fully " ripe " flower with the much enlarged and fleshy corolla. In this stage the style is about half an inch longer than it was in the first stage. Natural size.

Figs. 12–17 give sketches of a bud and flowers of different ages. The flowering branch was cut at 6-30 p.m. on the 9th April and the flowers were examined almost immediately after.

[In taking the exact measurement of the lengths of the sepals, corollas and styles the sections became slightly distorted and wider. The exact lengths are shown in the drawings.]

Fig. 12.—Sepals much longer than petals, style only a little longer than the sepals. Anthers immature and no pollen shed when tapped.

Fig. 13.—Pollen being shed and fleshy part of corolla still completely hidden under sepals.

Fig. 14.—Pollen being shed. Style and petal slightly longer than that of flower shown in Fig. 13.

Fig. 15.—Fleshy part slightly thicker than that in Fig. 13. Appears to be a bit older than that in Fig. 13.

Fig. 16.—Section of old flower in which corolla has fallen off. The style was much longer than the old style of that in Fig. 15, but the sepals were of the same length.

Fig. 17.—Section of old flower showing corolla shed and ovary slightly larger. Sepals the same length as that in Fig. 15, but style found to be exactly 1 cm. longer.

Figs. 18–31 give the sections of all the flowers found on a bunch which was examined about 8 a.m. Altogether there were fourteen flowers and none were destroyed by bats.

Fig. 18.—Quite a young bud.

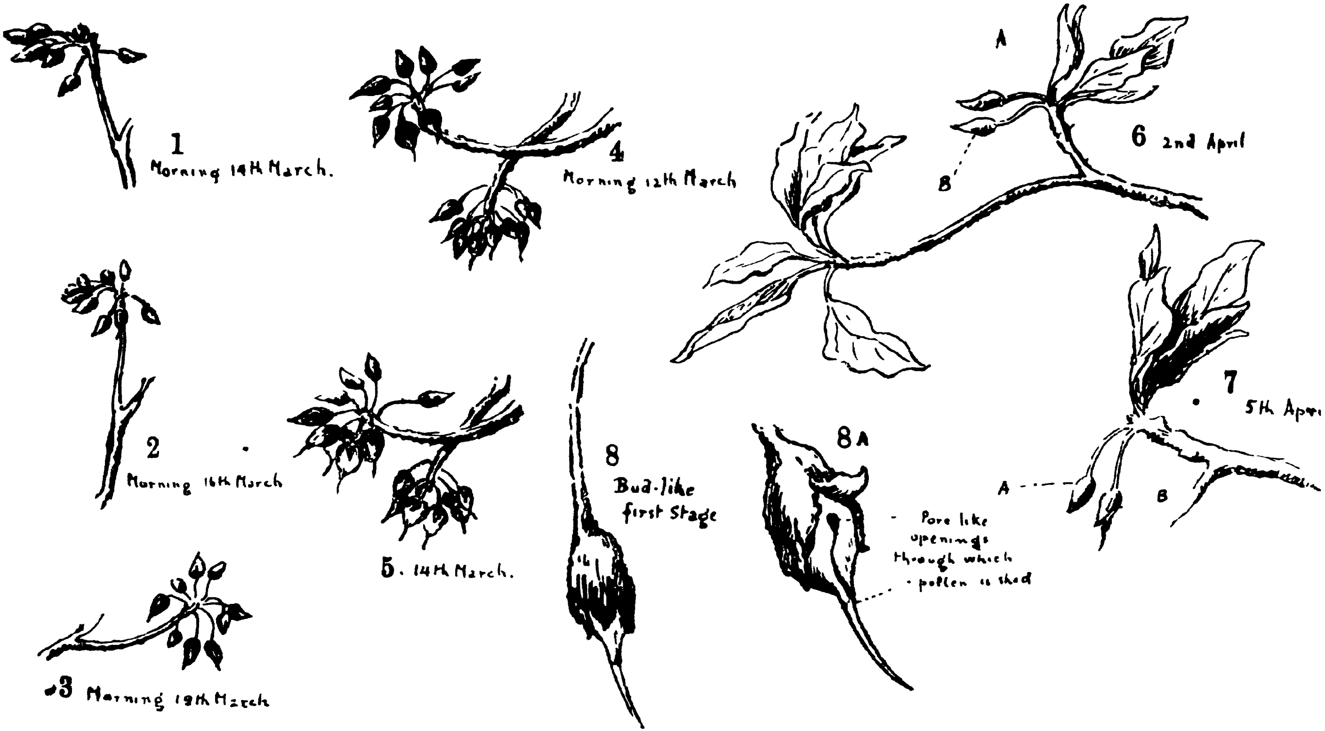
FIG. 19.—Flower in first stage shedding pollen.

FIG. 21.—Most of the pollen shed.

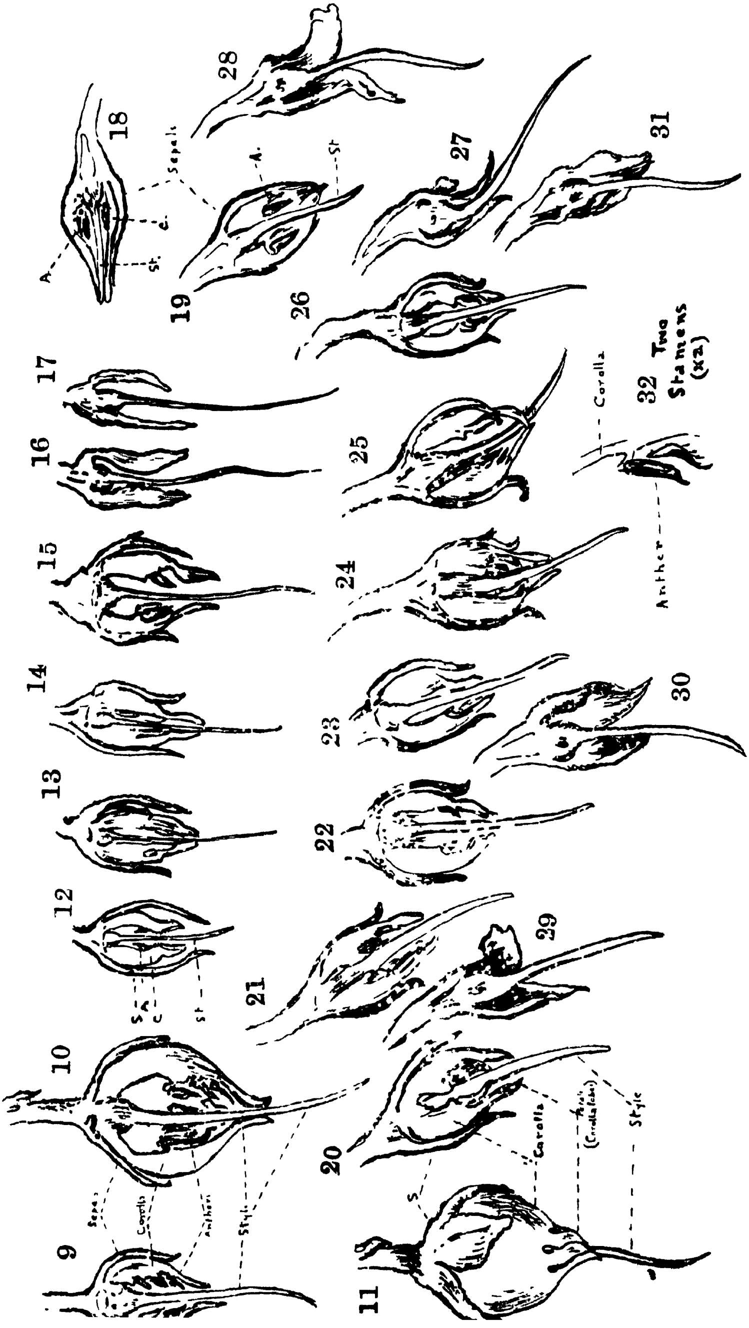
FIG. 26.—Pollen shed thickly.

FIGS. 29.–31.—Old flowers which have lost their fleshy corollas.

FIG. 32 shows two stamens enlarged about twice the natural size.



BAT-FLOWERS OF THE MOHWA



BAT-FLOWERS OF THE MOHWA.

FIG. 19.—Flower in first stage shedding pollen.
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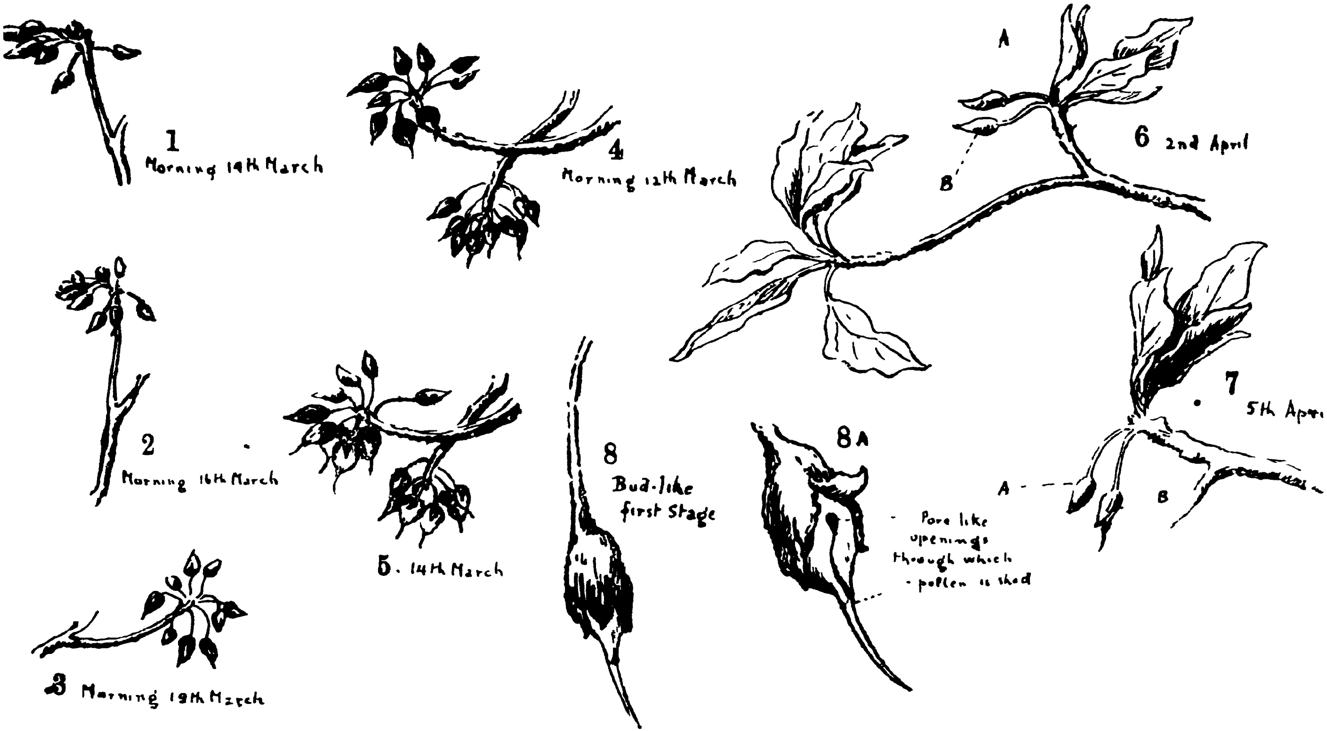
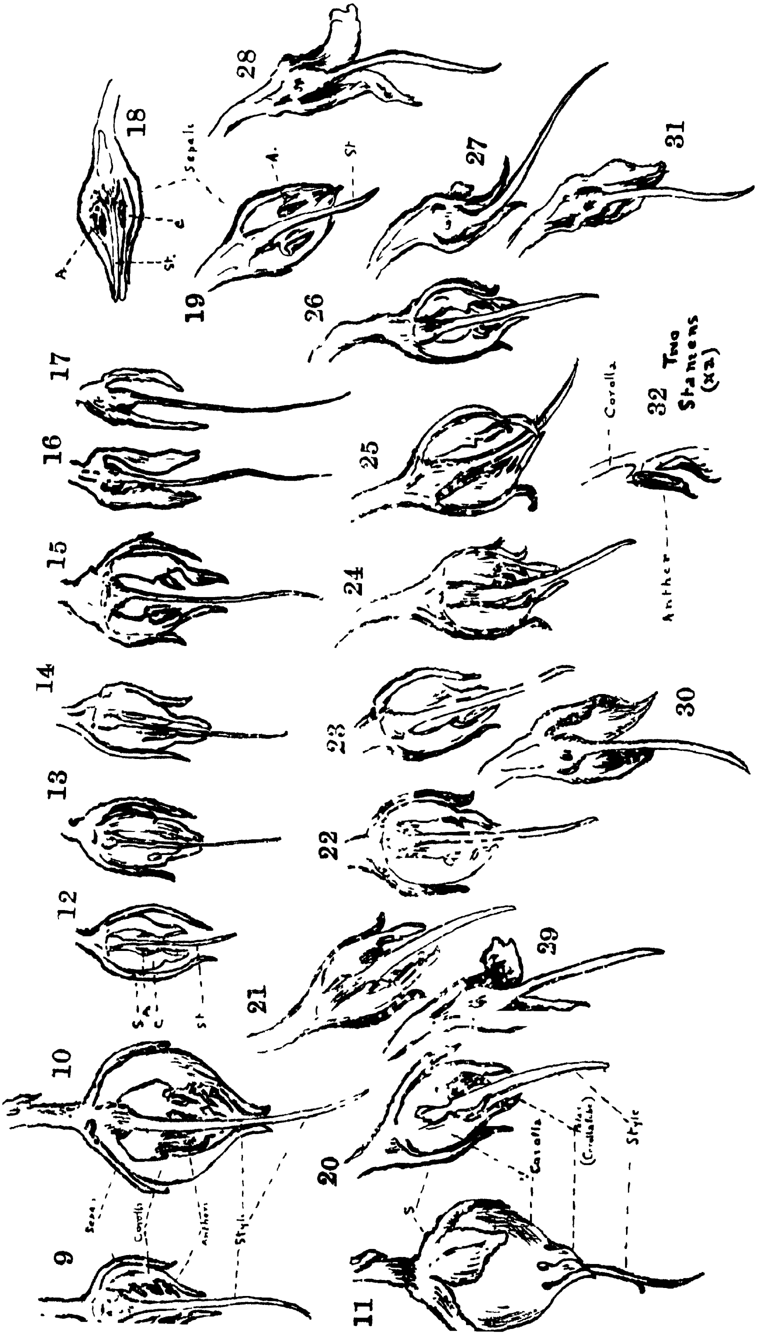


BAT-FLOWERS OF THE MOHWA



BAT-FLOWERS OF THE MOHWA.

38. On a new species of Cylindrospermum from Bengal— Cylindrospermum doryphorum, Brühl et Biswas

By Paul Brühl and Kalipada Biswas.

[Paper read at the meeting of the Asiatic Society of Bengal on the 7th of March 1923.]

The genus Cylindrospermum belongs to the Tribe Anabaeneae of the family of Nostocaceae. Dr. Forti, in De Toni's Sylloge Myxophycearum, page 471, defines the genus as follows:—

"Trichomata aequalia, brevia, evaginata, muco amorpho involuta, in stratum indefinite expansum aggregata; articuli cylindrici diametro longiores. Heterocystae terminales Sporae sub-heterocysta natae singulae rarius plurimae seriatae." The chief characters of the genus may therefore be taken to be the comparative shortness of the filaments, the shapeless mucous envelop. the aggregation of the filaments into a stratum of indefinite outline, the cylindrical form of the cells and particularly of the spores, which, where they occur, are placed singly rarely several in a row, immediately behind the terminal heterocyst

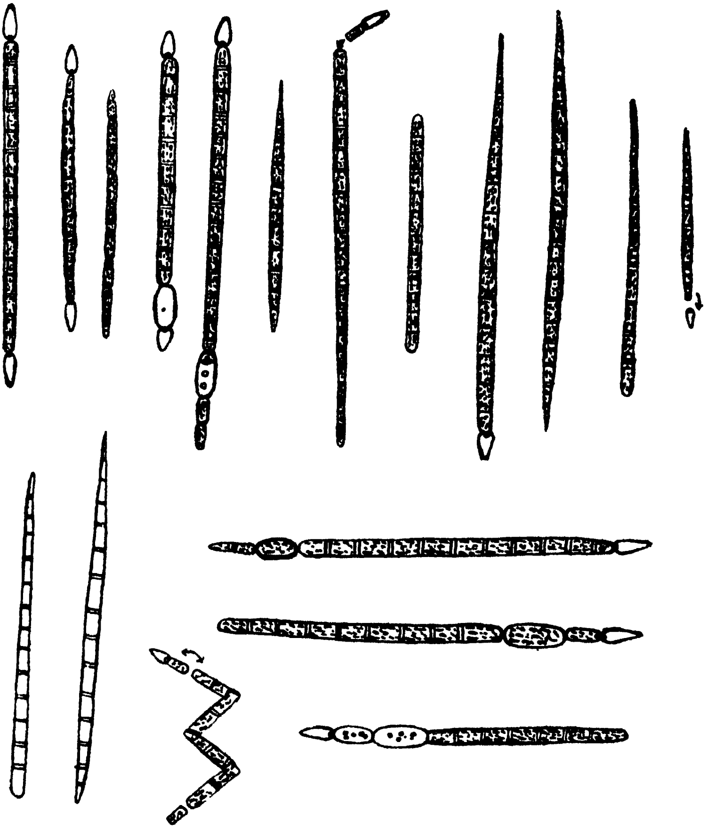
In our species the heterocysts are found one at either end of the filament. The filaments are, however, brittle, and it can often be observed under the microscope that one or both of the heterocysts, together often with one or two of the adjacent vegetative cells break off, after which the residual filament is left with only one or no heterocyst at either one or both the rounded or pointed ends. As a matter of fact, if a small portion of the stratum is spread out on a glass slide and covered with a cover glass, a considerable number of filaments are found with only one terminal heterocyst or with no heterocyst at all, so that it appears doubtful whether the heterocysts are always formed or not Future culture experiments will decide that question definitely. The contents of the heterocysts appear to be quite homogeneous and are coloured pale bluish-green. A peculiarity which distinguishes the heterocysts of our species from those of most of the Nostocaceae, is the shape of the heterocysts, which in microscopic view resemble lance-heads instead of appearing to be circular or oblong-elliptical; it is chiefly in certain forms of *Mastigonema aerugineum* in which the heterocysts are pear-shaped with rather pointed outer end, and in *Cylindrospermum Goetzei* the heterocysts are said to be "prorsum arcte attenuatae, apice acute rotundatae." The spear-head shape of the heterocysts has induced us to call the new species *Cylindrospermum doryphorum*, as this character seems to be quite constant. The heterocysts are 4–8 μ long and 2–4 μ in diameter at their widest part.

The vegetative cells are cylindrical, slightly or not at all constricted at the joints, 4–8 μ long and 2–4 μ wide, the length always exceeding the diameter but never, evidently, being more than twice as long as wide. A peripheral zone and the dissepiments are hyaline; within the peripheral zone there lies a zone containing granules which are more or less irregularly aggregated into longitudinal rows, whilst the axial portion is either hyaline or very finely granular.

Resting spores are rather scarce. Where they occur they are nearly always single and adjacent to the terminal heterocyst, but very rarely they occur in pairs, and sometimes they are separated from the heterocysts by one or a few vegetative cells. In some cases those larger cells contain only a few largish bluish-green granules, or their contents are quite homogeneous and of a pale bluish green colour, like that of the heterocysts; usually, however, their contents are rather densely and somewhat coarsely granular. They are clothed with a firm, smooth, hyaline membrane, are 8–12 μ long and 4–6 μ wide, and always wider than the vegetative cells.

The filaments are aggregated into cloud-like floating colonies of indefinite outline and a verdigris-green colour.

Of the species described by Professor Forti *Cylindrospermum tropicum*, a species found in Ceylon, differs in the filaments being constricted at the joints, in the heterocysts being twice as wide as the vegetative cells and in the spores being up to 43 μ in length; *C. Goetzei* has minutely punctate brownish yellow spores 12–20 μ long and 8 μ in diameter and the basal heterocyst differs in shape (see above); *C. minutissimum*, an American species, has oblong-cylindrical heterocysts and its spores are 18–20 μ long; in *C. stagnale*, a cosmopolitan species having quite a number of synonyms, the vegetative cells are 3 to 4 times as long as wide, the heterocysts are subspherical or oblong and up to 16 μ long, and the spores reach a length of 30 to 40 μ; *C. licheniforme*, the Kuetzingian figure of which reminds one of our species, has oblong-ellipsoidal, not spear-headed, heterocysts and its spores are 20-30 (—38) μ long; *C. maius* forms a blackish-green stratum, the dimensions of its vegetative cells decidedly exceed those of our species, and its spores are covered by a papillate epispore; *C. comatum* has flexuous filaments, subglobose yellowish heterocysts and yellowish brown spores with a granulate membrane, the spores being about 24 μ long; in the narrow-celled *C. minutum* (diameter 2–8 μ) the cells are more or less constricted at the joints, the heterocysts are globose and the spores minutely granulate and 16–19 μ long; the vegetative cells of *C. lobulatum*, a German species, are stated to be indistinctly granular, the heterocysts, *which occur at either end of the filament*, as is the case frequently in our species, are oblong or subglobose; the heterocysts of *C. muscicola*, a widely spread species, are oblong, the spores



Drawn by K P. Biswas.

Cylindrospermum doryphorum. sp. n.

are 10–20 μ long and of a golden-brown colour; *C. catenatum* differs in the spores occuring in a row of two to eight and in the elongate heterocysts, and the heterocysts of *C. humicola* are globose.

The single filaments can often be seen to move slowly straight onwards, different filaments moving in different directions.

We have to thank Mr. V. G. Raju of the Public Health Department for supplying us with the sample in which we discovered the new species.

The figures in the illustration represent different forms of filaments.

39. Observations on the Luminosity of some Animals in the Gangetic Delta.

By B. PRASHAD, D.Sc., *Zoological Survey of India, Calcutta.*

(Published by permission of the Director, Zoological Survey of India.)

This short paper is a record of some observations made by me during the years 1917–1920 on the luminosity of some of the animals found in the estuaries of the Gangetic Delta. My attention was directed to this problem by Dr. S. W. Kemp's paper[1] entitled "Notes on the Fauna of the Matlah River in the Gangetic Delta," in which he had recorded some observations of his own and pointed out the lines along which further work could be carried on. While engaged in Fishery investigations in this area I had exceptional opportunities for this work and devoted as much of my spare time as I could to it, and the results of my observations are here presented. Incomplete as the results are, they have the following points in their favour, that the observations were made on large numbers of individuals and that the investigations were carried out at practically all hours of the day and night and at different times of the year.

Before going on to the subject proper it may be noted that the Fauna of the various streamlets and creeks in the delta resembles that of the Matlah river, in that it is very rich in individuals though very poor in the number of species represented. This was fortunate for the investigation, as the circle of work was greatly narrowed and I was able to pay greater attention to the few species with which I had to deal. In the case of most of these also my results were negative, but in the case of four:—1. *Harpodon nehereus* (Ham. Buch.)—a fish, 2. *Leander tenuipes*, Henderson—a prawn, 3. a race of *Pleurobrachia globosa* and 4. *Beroe cucumis*. F8r —two Ctenophores, I was able to observe the production of light. As the methods of the production of light were different in different cases I will deal with each separately.

The interesting fish known to the scientists as *Harpodon nehereus* and popularly known as the "Bombay Duck" or the "Bummaloh" is fairly common in the lower reaches of the delta. This species along with the only other species of the genus (*H. microchir* from Japan) was considered from its peculiar structure by Günther[2] "to be evidently an inhabitant of considerable depths which periodically comes near the surface." About its luminosity the same author remarked "when newly taken its body is brilliantly phosphorescent." Kemp, however, was not able to corroborate this statement by his observations. During the course of nearly three years I had the chance of examining hundreds of freshly caught specimens taken in different places and at practically all times of the day and night, but except in the case of a single dead specimen none of them showed any signs of luminosity, not was I able to distinguish any traces of luminous organs on the body of this fish. The particular specimen was taken in a beam-trawl in about 5 fathoms of water at Port Canning on the 14th of April 1918. The season at this time of the year was pretty warm The specimen was unconsciously left in a bowl of estuarine water for nearly six hours on the open deck, when my attention was directed to it by a faint light that was to be seen in the bowl. On a careful examination it was found that the light was being emitted by the fish that had been left in the bowl. The light was of a faint bluish green colour and was not localized in any particular area, rather the whole body of the fish was luminous. I suspected that the luminosity in this case was probably due to bacteria, particularly as the fish was already partially decomposed and was emitting a faint smell. Its body was covered with a shiny substance which on examination under the high power of a microscope was found to be teeming with bacteria Working in an out of the way place like Port Canning and with my very limited knowledge of Bacteriology it was not possible to proceed very far with the identification of the bacterium but on consulting the literature on the subject on my return to Calcutta I was able to decide from my rough sketches and notes that the bacterium belonged to the family Bacteriaceae and was, probably owing to the flagella at one end of the organism, one of the *B. pflugeri* group.

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[1] *Rec. Ind. Mus.*, XIII, pp. 233-241 (1917).

[2] *An Introduction to the Study of Fishes*, Edinburgh, p. 584 (1880).

Luminous bacteria have been known for a long time and it will probably be not out of place to review the conditions under which these organisms show phosphorescence :--(1) They require a fair abundance of a nutrient medium like the dead bodies of fish, molluscs, etc., in which decay has just started, (ii) fair amount of moisture and a salty medium, (iii) temperature of about 40° C. and (iv) abundant supply of oxygen. Under these circumstances the bacteria have been shown by direct experiments to produce a secretion which ignites in the presence of the abundant supply of oxygen and produces a faint light.

It is, therefore, clear that the Bombay Duck is not naturally phosphorescent for it does not possess any light-producing organs of the type found in other fishes, which are known to be luminous, but that the phosphorescence, whenever observed, is due to bacteria which find a suitable medium in this fish and with all other suitable conditions in surroundings, like the Gangetic Delta, form large colonies on the body of the fish and becoming active produce light thus making the fish phosphorescent.

The second case was that of a number of specimens of *Leander tenuipes* (also dead) taken a day later at the same place as the above mentioned specimen of *Harpodon nehereus*. These specimens had been left in a dish after examination for clearing away. The assistant fortunately did not immediately clean the dish. Some four hours later, when he went to throw away the prawns, he found them all glowing, and brought round the dish to me for examination. In the case of these prawns the gills only were emitting a faint bluish-green light of about the same intensity as I had noticed in the case of the Bombay Duck. The rest of the body did not show any light; the branchiae of both sides only being luminous in the case of all the specimens in the dish. Undoubtedly in this case the light production was due to phosphorescent bacteria and this observation confirmed my views about the cause of the production of light by the solitary specimens of *Harpodon nehereus*.

As to the two Ctenophores a few words are necessary as to the nomenclature of the two forms I had to deal with. The first is a race of the common form *Pleurobrachia globosa*. Two races of it have been described from Indian waters. One by Browne[1] from the Gulf of Manaar as the race *ceylonensis* and the other which is found in the Chilka Lake and near Madras etc in the Bay of Bengal by Annandale and Kemp[2] as the race *bengalensis*. The specimens that I collected in the Sunderbans are intermediate to some extent between the two races and it is likely that only one form occurs in the Indian waters. The other Ctenophore is a Beroid and specimens of it brought back to Calcutta were identified as *Beroe cucumis*, Förskal, a form widely distributed in the East: probably it is the second Ctenophore which was found in the Chilka Lake, but no specimens of which could be secured and preserved by the Chilka Survey party of the Zoological Survey of India.

Our knowledge of the phosphorescence of these forms has been greatly extended of recent years by the work of Allman, Panceri, Peters and Dahlgreen ; the work of the last author contains an admirable summary of the previous work. As a result of their work we know that these Ctenophores do not show any light when at rest, nor is the movements of the swimming plates accompanied by light. The two modes of energy-release are, therefore, not connected, as are those of motion and heat or of motion and electricity in other animals. In warmer regions the light appears as a strong glow or a flash for a second or so after mechanical stimulation, while in colder waters the light is strong and appears as a steady glow lasting for a minute or more The light is localised in the region of the swimming plates, and the production of light is at its maximum at the optimium temperature at which the animals usually live; direct sunlight, however, inhibits luminosity, while mechanical stimulation accelerates the power to light. The light, as has been noted already, is produced in the region of the swimming plates only, and it has been established by histological investigations, that it is probably produced in special cells. Underneath the swimming plates are the water vascular canals, and linning these canals are the genital cells; lying distally to the genital cells are rows of large vacuolated cells. It is most probably in these cells that luciferine is secreted, and stored in the vacuoles The luciferine produces light by its combustion Curiously, however, the secretion of luciferine is not begun till the animals have been kept in darkness for some time or are brought into darkness, while combustion does not start till some stimulus of a mechanical nature is applied. It may also be noted that the combustion is of an intra-cellular nature.

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[1] Herdman's *Ceylon Pearl Fisheries*, IV, p. 61 (1905).

[2] *Mem. Ind. Mus.*, V, pp. 117, 118 (1915).

[3] *The Production of Light by Animals*, Pt. II, p. 9 (1916).

Coming now to my observations on these two forms, it may be noted that the two Ctenophores are fairly common in the Gangetic Delta. They were secured in fair numbers in a beam-trawl net unfortunately the mesh of the net was rather coarse, and owing to the strong current most of the specimens on the net being hauled were found to be badly torn; a few good specimens were, however, secured from time to time. For my observations the torn and broken specimens answered as well as the complete ones. In the case of these animals production of light was observed under the same conditions as those summarised above. No light was observed in pieces without the ciliated swimming plates, but in others, where even a small part of the plate was intact, a faint glow, lasting for half a second to a second, was observable at irregular intervals. In freshly captured specimens stimulation resulted in the production of light at more regular and shorter intervals. For stimulation gentle shaking of the water was quite enough.

In summing up the observations it may be noted that in the case of the animals observed in the Delta, true light-producing organs were found only in the two Ctenophores and that in the fish and prawn, which showed phosphorescence, the phenomenon was due to light producing Bacteria.

40. Revision of Kobelt's Nomenclature of the Indian Ampullariidae.

By B. Prashad D.Sc., *Offg. Superintendent, Zoological Survey of India.*

During 1909-1916, Sowerby published in the *Proceedings of the Malacological Society of London*[1] notes on the family Ampullariidae in the form of a critical Catalogue. This work, according to the author, was the result of a "careful study and comparison of the very numerous shells of this family to which I have had access," and was styled by Kobelt "Sorgfältig gearbeiteten Catalog." In working out the large collections of this family in the Indian Museum. Calcutta, I found it impossible to agree with Sowerby's conclusions, and in many cases to understand his interpretations In view of my proposed tour to the various European Museums, I, therefore, postponed the completion of this work till I had myself examined the collections in the British Museum, London, and had also seen the specimens figured by Kobelt in his recent Monograph in *Mart.-Chemn. Conch.-Cab.* Having now had the opportunity of examining both these collections and comparing the large Indian collections which I had taken over with me to Europe, I take this opportunity to publish a short revision of Kobelt's nomenclature of the Indo-Burmese species. The detailed results of my investigations on the Indo-Burmese species will be published later in the "Memoirs of the Indian Museum," Calcutta

It will not be out of place to remark here on the unsatisfactory nature of the three Monographs on the Indian Ampullariidae published during recent years.

First of these is the Monograph by Kobelt. It was begun in 1911, and completed in 1915: the part dealing with the South Asiatic species, however, was published in 1912. In the preparation of this part Kobelt had the advantage of consulting Sowerby's Catalogue referred to already and had also received by purchase shells of a fair number of Indian species identified by Sowerby from Sowerby and Fulton. London. Kobelt, however, was not in a position to analyze Sowerby's Catalogue critically, and his work on the Asiatic species, as he himself says, suffers greatly because of the paucity of specimens available. A great number of the mistakes are also due to the too great reliance he placed on Sowerby's work, as also the carelessly named shells that Kobelt received from the same source. Sowerby's Catalogue, or at least the part dealing with the Indian species, was published prior to Kobelt's work It is a very useful compilation, but is, at least for the Indian species, in no sense critical. The last and the most recent revision of the Indian species is that by Preston published in his volume[1] on the Freshwater Gastropod and Pelecypod Molluscs of India It is, unfortunately, nothing more than a reprint of the original descriptions of the various species. The author did not avail himself of the recent work of Sowerby, beyond including the latter's description of his new species *Ampullaria* (*Pila*) *alucinans*, from Ceylon. He entirely ignored, Kobelt's Monograph, and does not even refer to all the literature on the subject.

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[1] Sowerby *Proc. Malacol. Soc London*, VIII, pp. 354-364 (1909). IX, pp. 56-64 (1910) and XII. pp. 65-73 (1916).

Before going on with the systematic part, I would like here to express my great indebtedness to Mr. G. C. Robson of the British Museum. London, and to Dr. F. Haas of the Senckenberg Museum, Frankfurt-a-Main, for the facilities afforded me for examining the collections under their charge.

Pachylabra largillierti (Philippi) var.

1912. *Pachylabra largillierti*, Kobelt, *op. cit.*, p. 59, Taf. xxxiii. fig. 9.

Kobelt in his work gave the figure of this species from Reeve's *Conchologia Iconica* and compared it shortly with Philippi's figure of the type in his Monograph in the old edition of Martini and Chemnitz He does not say anything about the habitat of the species nor did he note here the specimen from Mousson received as '*Ampullaria paludinoides*, Jan., Ostindien,' but which Kobelt had labelled as *largillerti*, Phil. This specimen is nothing more than a large specimen of the common South Indian species—*Pachylabra virens* (Lam.).

It may also be noted here that *P. largillierti* is an African species. occuring in Madagascar and probably in South Africa.

Pachylabra globosa (Swainson).

1912. *Pachylabra globosa*. Kobelt, *op cit*, p. 72, Taf. xxxiv, figs. 1, 2, var. *encaustica*, p. 95, Taf. xli, fig. 1.

In his account of this species, Kobelt was obliged to leave out the discussion of the synonymy and variation owing to insufficient material. He, however, included an extract from Nevill[2] regarding the various forms considered by the latter author as forms or varieties of this species. Having examined Nevill's original specimens and the very large series of shells in the Indian Museum, and the type-specimens of the various forms in the British Museum, as also large numbers of living specimens from different localities, I have come to the conclusion, that the forms *encaustica*, Reeve ; *corrugata*, Swainson ; *sphaerica*, Hanley and Theobald ; *fasciata*, Hanley and Theobald ; *incrassatula*, Nevill ; *minor*, Nevill and *longispira*, Nevill, are only phases of this variable species, and that it is impossible to distinguish them as distinct owing to the great variation exhibited by specimens from various localities. The question will be discussed at length in my detailed paper.

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[1] *Fauna of British India Series, Mollusca, Gastropoda and Pelecypoda* (*Freshwater*), London (1915).

[2] Nevill *Hand List Moll. Ind. Mus.*, Part II, pp. 1, 2, *Calcutta* (1885).

Pachylabra layardi (Reeve).

1912. *Pachylabra layardi*, Kobelt, *op. cit.*, p. 73. Taf. xxxiv, figs. 3, 4.

This interesting species of *Pachylabra*, from Ceylon, has a very chequered history. Nevill, the first author to remark on this species after Reeve, originally considered it as being identical with *carinata*, Swainson (*virens*, Lamarck), but later regarded it as a distinct variety of *globosa*, Swainson. Sowerby included it as a variety of *virens*, Lam. , while both Kobelt and Preston treated it as a distinct species. As a result of a careful examination of a large series of shells, I am of opinion, that the species, though closely allied to both *virens* and *globosa*, is quite distinct, and is confined to the island of Ceylon.

Pachylabra layardi (Reeve) var. **cinerea** (Reeve).

1912. *Pachylabra cinerea*, *P. Tischbeini* and *P. alucinans*, Kobelt, *op. cit.*, pp. 89, 100 and 104, Taf. xxxv, fig. 9 ; xlii, figs. 1, 2 ; xliii, fig. 8.

Kobelt treated the three forms referred above as distinct. He, in adopting this course, followed Reeve and Sowerby, for at the time he had only a single shell of the form considered as *P. tischbeini* by Sowerby. I have examined the types of the three species in the British Museum, London, and have besides seen large numbers of specimens, and am of opinion, that they are all specimens of the same species ; further that this form is nothing more than only a variety of the common Ceylonese species *P. layardi*.

Kobelt since publishing his account of these forms had received specimens of the other species from Sowerby and Fulton, and a few notes about these specimens will also be included here.

Two specimens received with the label " *Pila globosa* var *cinerea*, Reeve " in Sowerby's handwriting, belong to two species. One is a specimen of *cinerea*, a variety of *P. layardi* and not *P globosa* ; while the other is a half-grown shell of the other Ceylonese species—*P. doliodes.* Another shell received from the same source as "*Pila tischbeini*, Dohrn " belongs to the variety *cinerea.* A specimen, which Sowerby sent as the cotype of his new Ceylonese species—*P. alucinans*—is the most interesting of the lot. It is a young shell of a uniform dark-brownish colour, without any colour bands, as are present in Sowerby's type-shell. The umbilicus is more perforate, and is not fully covered over by the somewhat narrow collumellar border. The mouth of the shell has quite a different shape. and the shell is thick with distinct vertical striae. This specimen, except for being of about the same size as Sowerby's type of *P. alucinans*, has nothing in common with it. It is only a young specimen of the Burmese and East Indian species—*P. conica* (Gray).

Pachylabra doliodes (Reeve).

1912. *Pachylabra doliodes* and *P. moesta*, Kobelt, *op cit.*, pp. 74. 75, Taf. xxxiv, figs. 5, 6 and 8.

Reeve described this species from a shell in the Cuming Collection with the locality 'Bombay.' Nevill, however, thought the species to be Ceylonese, but Sowerby, from one of the three shells mounted on the type-tablet being an American species was misled, and considered the species to be an American one, belonging to the genus *Ampullaria*, s. s The type-shell, which was figured by Reeve as *A. doliodes*, corresponds exactly with the specimens from Ceylon, which Nevill had assigned to this species. Reeve's *Ampullaria moesta* from Ceylon is only based on young shells of this species, and must be included in the synonymy of this species.

In Kobelt's collection there is a young specimen of this species purchased from Sowerby and Fulton, London. This shell, as has already been noted, was received as a specimen of *globosa* var. *cinerea.*

Pachylabra doliodes (Reeve) var. **woodwardi** (Dohrn).

1912 *Pachylabra woodwardi* Kobelt, *op. cit.*, p. 105, Taf. xliii, fig. 9.

This form is only known from Dohrn's unique type-specimen in the British Museum, London The type is a young shell and greatly resembles the young shells of *P. doliodes.* I was at one time inclined to consider it as only an abnormal specimen of the same species ; but owing to the very perforate nature of the shell, the very loose winding of the whorls and the much darker colouration, as also the differences in the proportionate masurements, I, for the present, propose leaving it as a distinct variety.

Pachylabra virens (Lamarck)

1912. *Pachylabra maura*, Kobelt, *op cit.*, p. 85. Taf. xxxv, fig. 2; and *P. paludinoides* Kobelt (*nec* Chr. and Jan.) *in part*, p. 102, Taf xl, fig. 6, and xliii, fig. 3.

Kobelt's account of this species based on Reeve is far from complete. He, as I have pointed out already, mistook one of the shells of this species for *P. largillierti*: and has altogether missed out the forms *virens*, Lam., *carinata*, Swain., and *malabarica*, Phil., all of which, however are only synonyms of this species.

It is of interest to note here, that the shell from the München Museum, figured by Kobelt (Taf. xl. fig. 6) as probably the type-form of *P. paludinoides* (Phil) is also a specimen of this species, and so is also the fig. 3 (Taf xliii) copied from Reeve; only this specimen is a little more globose than is normally the case The species, however, has a very wide range and varies greatly in the form of the shell.

In addition to the specimens of this species noted in accounts of the other species, other are in the Senckenberg Museum two typical specimens from Madras, India, labelled *Ampullaria carinata* var. *malabarica*, Phil.

Pachylabra theobaldi (Hanley).

1912. *Pachylabra theobaldi*, Kobelt, *op. cit*, p. 86, Tat xxxv, fig. 1.

Kobelt had a young specimen of this beautiful species from Boettger's collection from Moulmein, Burma, labelled *Ampullaria paludinoides*, Christ., but he apparently did not recognize the species He has included the description from Hanley's original account of the species, and copied the figure from "Conchologia Indica." He does not make any reference to Pilsbry's Burmese species *A. winkleyi*,[1] which, however seems to have been based on only young shells of this species

Pachylabra conica (Gray).

1912 *Pachylabra conica* Kobelt, *op. cit.*. p. 93, Taf. xl, figs 1-5, 8, 9.

The identification of this species and its varieties has been greatly confused by Kobelt, who in his notes has mainly followed Reeve and Sowerby. The figure of the typical form copied from Reeve as fig. 1 (Taf. xl) is a correct representation of the typical form His figures 2 and 3 are of a Javanese shell in the Moellendorf Collection; this shell and the one delineated on the same plate as figs. 4 and 5, also from the same collection, are not the connecting links to Reeve's *javanica*, as Kobelt thought, but specimens of true *A. javanica*. Kobelt was doubtful about them owing to the specimens being a little more rounded than Reeve's figure of *javanica*; I have examined the type of this latter form and found that it is much more rounded than is represented in Reeve's figure.

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[1] Pilsbry, *Proc. Acad. Nat. Sci. Philadelphia*, LIII, p. 189, pl. v, figs. 2, 3 (1901).

I had in a recent paper[1] included Reeve's *javanica* in the synonymy of *conica*, but was not sure as to whether it was a distinct variety. Having now examined a fair series of shells, I am of opinion that the Javanese species deserves to be considered as a distinct variety.

Kobelt's figures 8 and 9, of a shell from Boettger's collection labelled *Ampullaria conica* var. *orientalis*, Phil., which he included here, but was doubtful as to whether it was not a distinct form, is only a young specimen of *compacta*, Reeve, which, in my opinion, is only a variety of *P. conica*.

Pachylabra conica (Gray) var. **compacta** (Reeve).

1912. *Pachylabra compacta*, Kobelt, *op. cit.*, p. 100, Taf. xlii, figs. 3-9.

As I have noted already in my notes on the species *P. conica*, I consider this form to be only a variety of that species. Kobelt's figures on plate xlii are all correctly referred to this species, but as I have already noted, his figures 8 and 9 on Taf. xl, is also of a young shell of this species, and so is also the figure of *paludinoides*, copied from "Conchologia Iconica" as fig. 3 (Taf. xliii).

Pachylabra conica (Gray) var. **expansa** (Nevill).

1912. *Pachylabra paludinoides*, Kobelt, *op. cit.*, p. 102 Taf. xliii, fig. 2.

The figure cited above, which Kobelt copied from "Conchologia Indica" is, as I have satisfied myself by examination of the original specimen in the British Museum, London, of a specimen of this variety.

Pachylabra paludinoides (Philippi).

1912. *Pachylabra paludinoides*, Kobelt, *op. cit.*, p. 102.

As Kobelt rightly remarks, it is quite impossible to indentify the species originally designated as such by Christ., and Jan., he, therefore, recognized the species as restricted by

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[1] Prashad, *Rec. Ind. Mus.*, XXII, p. 477 (1921).

Philippi. As I have remarked already Phillipi's species is nothing more than *P. virens* (Lam.). It would under the circumstances be best to ignore the name *paludinoides*, Christ., and Jan., and to include Phillipi's name in the synonymy of *virens* (Lam.).

Genus Turbinicola, Annandale and Prashad.

1912 *Turbinicola*, Annandale and Prashad, *Rec. Ind. Mus.* XXII, p. 9.

In the paper cited above Dr. Annandale and I have given reasons for separating the Ampullarid from the hill-streams near Khandalla, Bombay, into a new genus. This species has hitherto been known as *Ampullaria nux*, Reeve. Unfortunately, however, Reeve described shells of this species first as *A. saxea* and later as *A. nux*, as was found on examination of the types of the two species. The name of the species, therefore, must henceforth be *Turbinicola saxea* (Reeve).

Turbinicola saxea (Reeve).

1912. *Pachylabra nux* and *P saxea*, Kobelt, *op. cit.*, pp. 82, 89, Taf. xxxvii, figs. 5, 6, and xxxv, fig. 7.

Kobelt when writing his account of these two species had no specimens of either, and copied the descriptions and figures form Reeve. Later he received from Sowerby two specimens labelled "*Pila saxea*, Reeve; Pegu." The two shells curiously enough have the localities 'Bombay' and 'Goa' written on them inside the mouth, probably by the collectors. These localities were certainly not noticed by Sowerby when he gave his fanciful locality 'Pegu' for the two shells. The two shells belong to two different species, one is a young shell of *P. virens* (Lam.), from Goa; and the other from Bombay is a specimen of *T. saxea* (Reeve).

It may also be noted here that the species *Ampullaria heptaria*, Reeve (Kobelt, p. 74) and *A. bilineata*, Reeve (Kobelt, p. 96) are not Indian species. *A. heptaria*, as Sowerby thought, is a true *Ampullaria*, and is a South American species; while *A. bilineata* is probably a synonym of *P. conica* (Gray), from the Eastern Archipelago.

Proceedings
# of the
Asiatic Society of Bengal
for 1921.

[*Journal and Proceedings of the Asiatic Society of Bengal*]

Proceedings, Asiatic Society of Bengal, 1921.

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Proceedings of the Annual Meeting, 1922.

FEBRUARY, 1922.

The Annual Meeting of the Asiatic Society of Bengal was held on Wednesday, the 2nd February, 1922, at 9-15 P.M.

The HON'BLE JUSTICE SIR ASUTOSH MOOKERJEE, KT., C.S.I., D.L., D.Sc., F.R.S.E. F.A.S.B., President, in the chair.

The following members were present :—

Babu Chotilal Jaina, Babu Hem Chandra Ray Choudhury Khan Saheb Moulvi Abdul Wali. Babu Ramesh Chandra Majumdar, Mr. H. Bruce Hannah, Rev. E. Francotte, Rev. Fr. H. Hosten. S.J., Mr. M. J. Seth, Babu S. N. Bal. Dr. P. Brühl, Major R. Knowles, Khan Bahadur Said Abdul Latif. Babu Satish Chandra Kar, Dr. Upendra Nath Brahmachari Babu P. N. Banerjee, Babu Rama Prosad Mookerjee, Mr. K. N. Dikshit, Mr S. K. Belvalkar, Babu S. K. Mitra, Babu Nirmal Chandra Chatterjee, Babu Pramatha Nath Banerjee, Mr. Johan van Manen, Mr H. W. B. Moreno, Dr. W. A. K. Christie. Major T. C. Boyd. Col. T W W. Megaw, Dr. Napier.

The President ordered the distribution of the voting papers for the election of Officers and Members of Council for 1922, and appointed Mr. R. C. Majumdar, Mr. Ray Choudhury and Dr L. L. Fermor to be scrutineers.

The President announced that the Elliott Prize for Scientific Research for the year 1921, would not be awarded as no Essays had been received in competition.

The Annual Report was then presented

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ANNUAL REPORT FOR 1921.

The Council of the Asiatic Society of Bengal has the honour to submit the following report on the state of the Society's affairs during the year ending 31st December, 1921

Member List.

The number of Ordinary Members at the close of 1921 was 359 as against 368 at the close of 1920. The number of

Ordinary Members elected during 1921 was 27, of whom 5 have not yet paid their entrance fees: the name of one member was transferred from the Ordinary Member list to the list of Hon. Fellows. The number of Ordinary Members thus added to the list is therefore 21. On the other hand 14 withdrew, 6 died, 6 were struck off under Rule 38, and 4 were struck off under Rule 40.

The number of Ordinary Members in the past six years were as follows:—

YEAR.	PAYING.				NON PAYING.			GRAND TOTAL.
	Resident.	Non-Resident.	Foreign.	Total.	Life.	Absent.	Total.	
1916	145	159	18	322	25	60	85	407
1917	150	144	15	309	24	45	69	378
1918	153	145	17	315	24	43	67	382
1919	141	128	15	284	25	64	89	373
1920	161	134	15	310	26	32	58	368
1921	160	132	16	308	25	26	51	359

The following members died during the course of the year:—

Mr. Jagendra Nath Das-Gupta, B.A., Barrister-at-Law; Babu Pratapa Chandra Ghosh, B.A., Lala Roormall Goenka; Shaikh Laiq Ahmad Ansari; Dr. Suresh Prasad Sarvadhikari; and Lieut.-Col. C. T. Peters, M.D., I.M.S. (retired).

There was one death among the Hon Fellows, viz.:— Professor E. B. Tylor, D.C.L., LL.D., F.R.S. During the year we have elected Dr. F. W. Thomas of the India Office an Hon. Fellow. The number of such is now 28.

The number of Special Honorary Centenary Members remained unchanged, viz. 2. There was only one Associate Member elected, viz. Prof. Shahay Ram Bose. The number now stands at 12.

Fellows of the Society.

At the annual meeting held on the 2nd February, 1921, Lieut.-Col. F. Wall, C.M.G., I.M.S., U. N. Brahmachari, Esq., M.D., M.A., Ph.D., and B. L. Chaudhuri, Esq., D.Sc. F.R.S.E., were elected Fellows of the Society.

On the recommendation of the Fellows resident in Calcutta, the following additions to the regulations regarding the election of Fellows were accepted by the Council of the Society :—

(1) That in Rule 2 A, the following words be added at the end of the first sentence :—

"One at least of whom shall certify that he is personally acquainted with the scientific or literary work of the candidates he proposes and is in a position from his own knowledge to express an opinion on its value."

(2) That the following be added as Rule 2 B :—

"Any candidate who canvasses for support in his candidature shall be disqualified for election."

The name of one Fellow viz :—Dr M. W. Travers, F.R.S., has been removed from the list of Fellows in accordance with Rule 40, being more than 3 years absent from India, and he has ceased to be a Fellow under the Society's Rule 2 A.

The list of Fellows, now stands at 40.

Office Bearers.

In February, 1921, Dr S. W. Kemp reported that he would be absent from Calcutta for about six weeks and Dr. Baini Prashad officiated during the period as Biological Secretary of the Society. In March 1921, Prof D R. Bhandarkar left Calcutta, and Mr. Rama Prasad Chanda acted for him as the Joint Philological Secretary, and continued to perform his own duties as Anthropological Secretary. Major R. Knowles left India for eight months and Dr. U. N. Brahmachari acted for him. Mr. O Martin continued as the Honorary Treasurer throughout the year until the 24th November. Mr. Harley agreed to carry on the work until a successor was appointed Mr. W W K. Page has consented to stand for election as Honorary Treasurer at the next annual election Mr. A H. Harley continued as Honorary General Secretary throughout the year with the exception of one month when Dr. W. A. K. Christie took charge of the work.

There have been no changes among the officers of the Society since the last annual election.

Office.

Mr. J. H Elliott continued as Assistant Secretary during the year and gave prompt attention to the duties of his post.

Pandit Mathuranath Majumdar, Resident Pandit in charge of the Government MSS, was granted leave for three months on full pay from 1st April to 30th June, 1921, on the ground of ill-health. In November, 1921, he made another application for leave for another six months on the ground of ill-health, but Council refused further leave until he had checked the Government MSS. collection under the supervision of the Joint Philological Secretary.

Maulavi Hafiz Nazir Ahmad, First Travelling Maulavi attached to the Arabic and Persian Search Department, has been granted an extension of leave for another three months in continuation of the year's leave granted to him from 14th December, 1920, and Maulavi Shah Moinuddin Ahmed is still acting for him. Maulavi Asaduzzman Khan was granted leave from November, 1920 to February 21st on full pay. He returned to duty from February 22nd to February 28th, but was again granted leave from March 10th to April 25th on half pay, and from April 26th to September 30th without pay. He made another application for leave for three months from October to December, and three months' leave has been granted to him on half pay. He has not yet returned to duty. For the Department of Search for Arabic and Persian MSS. the Council has apointed Maulavi Nuruddin Ahmad and Maulavi Abdul Hadi Zahoorul Huq on probation for six months. Certain leave rules affecting the Society's staff and recommended for trial for a year by the Council were placed before the Monthly General Meeting in December 1921, and passed.

Society's Premises and Property.

The Council has received the following reply from the Government of India as regards the clear title to the Society's land :—

"With reference to your letter No 205, dated the 18th February, 1921. I am directed to say that the Government of India are advised that the land, on which the present premises of the Asiatic Society of Bengal are erected, must be regarded as the property of the Society subject to the payment of an annual rent, which, however, is remitted while the Society actually occupies the land They have therefore no objection to the land being mortgaged by the Society."

Negotiations for the loan of money from the Imperial Bank of India for the construction of the new premises have been instituted. Plans, etc., are practically complete. Before proceeding to the erection of the new premises, however, the Society must arrange for the accommodation of its library during the two years that will be required for their construction. The Government of India have stated that they are not certain whether they will be able to provide accommodation in one of the Government of India's buildings in Calcutta for the Society, and the matter will be duly considered six months later.

Indian Museum.

No presentations were made over to the Indian Museum. The Director of the Zoological Survey of India was granted permission to send in exchange to the Lucknow Provincial Museum certain duplicate specimens from the ethnological collections belonging to the Society in the Indian Museum.

During the year there has been no change in the Society's Trusteeship, the Hon. Justice Sir Asutosh Mukhopadhyaya, Kt., C.S.I., D.Sc., F.R.A.S., F.R.S.E., F.A.S.B., continuing to be a member of the Board of Trustees on behalf of the Society under the Indian Museum Act X of 1910.

Indian Science Congress.

The Eighth Annual Meeting of the Indian Science Congress was held in Calcutta from January 31st till February 5th. 1921, under the presidency of His Excellency the Rt. Honourable the Earl of Ronaldshay, G.C.I.E., Governor of Bengal. The abstracts of the scientific papers communicated to the Congress are in the press and copies will be sent to the members when published

It was arranged that the Ninth Annual Meeting of the Indian Science Congress should be held in the Medical College, Madras, on January 30th, 31st February 1st, 2nd, 3rd, 4th. 1922. His Excellency the Rt. Honourable Baron Willingdon of Ratton, G.C.S.I., G.C.I.E., G.B.E., Governor of Madras, consented to be Patron, and C. S. Middlemiss, Esq., C.I.E., M.A., F.A.S.B., F.R.S., was appointed President, and J. L. Simonsen, Esq., Ph.D., F.I.C., F.A.S.B., and C. V. Raman, Esq., M.A., Ph.D., Honorary General Secretaries, and Capt. C. Newcomb M.D., A.I.C., I.M.S., Chemical Examiner, Madras, and Khan Sahib Md. Azizullah Sahib Bahadur, B.A., M.B., C.M., Chemical Examiner's Office, Madras, Local Secretaries, and the Honourable Sir Lionel Davidson, K.C.S.I., I.C.S., Chairman of the Local Committee.

Meetings.

The Society's General Meetings have been held regularly every month with the exception of the month of November when those present did not constitute a quorum. No meeting was held during the recess month of October.

Deputations.

The Society received a communication from the Joint Secretaries, Second Oriental Conference, intimating that the Conference will be held in Calcutta from Saturday, 28th January 1922 to Tuesday 31st January, and inviting the Society to send delegates and representatives to the Conference. The Council appointed all the officers and members of Council as its representatives.

Agencies.

In succession to Mr. Bernard Quaritch, the Council has re-appointed Messrs. Luzac & Co. as the Society's London Agents. The latter were asked to take over from Mr. Quaritch the entire stock of the Society's publications including the Bibliotheca Indica. They have now taken them over and sent a list of them to the Society. Several consignments of books have been sent to them during the year. During 1920 a large consignment of six boxes containing the *Bibliotheca Indica* publications asked for by Mr. Paul Geuthner, the newly appointed Society's Agent in France, was sent.

With reference to Messrs. Otto Harrassowitz regarding his re-appointment as the Society's Continental Agent, the Council has re-appointed him on condition that his two outstanding accounts amounting to Rs. 1,823-8-10 are settled. The Society is in correspondence with the Controller, Local Clearing Office (Enemy Debts Department), Simla, for the recovery of the amount.

On an application from Mr. A. C. Coomaraswamy on the subject of establishing an Agency in the United States, and proposing that the firm "Orientalia,' Oriental Booksellers, 22, East 60th Street, New York, the Council agreed to offer the firm the Agency for one year for the present, on condition that the firm furnish the Society with a reference to a business firm in America. The manager of the "Orientalia" was written to but no reply has yet been received.

Barclay Memorial Medal.

On the recommendation of the Barclay Memorial Medal Special Committee, the Council awarded the medal for 1921 to Lieut.-Col. Sir Leonard Rogers F.R.S., C.I.E., F.R.C.S., M.D., B.Sc., F.R.C.P., I.M.S. (retired).

Elliott Prize for Scientific Research.

The subject selected for the Elliott Prize for Scientific Research for the year 1921, was Geology and Biology (including Pathology and Physiology) and the notification appeared in the *Calcutta Gazette*, dated 26th January, 2nd and 9th February, 1921. Only one essay, entitled "Possibilities of Mushroom-industry in India by cultivations" together with a printed abstract of another article, "Artificial Culture of spore of Panæolus cyanescens (Agaricaceæ)," by Prof. S R. Bose, was received. As these papers had not been published, the Trustees decided that they were unable to accept them in competition for the Elliott Prize for 1921 in accordance with the rules, and the articles were returned to the author.

There being no other essays received, no award was made, and no prize for 1921 will therefore be presented at the annual meeting of the Society in February 1922.

The subject selected for the Elliott Prize for the year 1922 is Mathematics. This notification will be published in the *Calcutta Gazette* in January 1922.

Finance.

The Appendix contains the usual statements showing the accounts for the year 1921. Statement No. 19 shows the Balance Sheet of the Society and of the different funds administered through it.

The credit balance at the close of the year is Rs. 2,14,171-0-4, against Rs. 2,04,902-6-5. Of this amount Rs. 1,71,600 belongs to the Permanent Reserve, the working balance, exclusive of funds administered for Government, being Rs. 42,571 as against Rs. 33,902 at the end of 1920.

The Society has received the usual grants of Rs. 20.800 and Rs. 5,000 from the Government of Bengal and India respectively :—

From Government of Bengal—	Rs.	*Vide* Statement
Anthropological Fund ..	2,000	No. 1
Bureau of Information ..	1,200	,, 5
Oriental Publication Fund No. 1	9,000	,, 9
Do. No 2	3,000	,, 10
Sanskrit MSS. Fund for cataloguing and preservation of MSS...	5,600	,, 11
TOTAL ..	20,800	

From Government of India—	Rs.	*Vide* Statement
Arabic and Persian MSS. Fund..	5,000	No. 12.

Statement No. 13 contains an account of the Society's investments in Government Securities which are held in deposit by the Imperial Bank of India. We hold 3½% Government Promissory Notes of the face value of Rs. 2,74.200. They cost Rs. 2,73,206-3-10, the average purchase price being Rs. 96-1-6. The market price at the time of writing this report is nominally Rs. 59-4. We also hold 4% Government Terminable Loan of 1915-16 of Rs. 10,100 purchased at par. In addition we have 3½% Government Promissory Notes of the face value of Rs. 500, belonging to the Barclay Memorial Fund

Statements Nos. 14 and 15 show how the current Bank balance is temporarily invested in War Bond and Treasury Bills.

Statement No. 16 gives an account of the amount due to and from the Society by way of subscriptions, publications and contingent charges.

In statement No. 17 is shown the sum reserved, with interest thereon, kept in deposit with the Chartered Bank of India, Australia and China, London, for printing the Kashmiri Dictionary in London.

The Budget estimates for the year 1921 were:—Receipts Rs. 25,203, Expenditure Rs. 23,002. The actual receipts are Rs. 32,171-6-0, including the "admission fees," and the actual Expenditure Rs. 21,809-9-9, including "repairs," "summer clothing" and "furniture" which were not provided for in the Budget estimate. The financial position of the Society therefore shows an improvement of nearly Rupees nine thousand three hundred over last year.

During the year we have received Rs. 656 from Admission fees, and as usual the Permanent Reserve has been increased by Rs. 600 (face value) transferred from the Temporary Reserve. The Permanent Reserve now stands at Rs. 1,71 600 (face value).

The Budget estimate of probable Receipts and Expenditure for the year 1922 is as follows:—

Receipts	Rs. 26,264
Expenditure	,, 24.271

BUDGET ESTIMATE FOR 1922.

Receipts.

	1921. Estimate.	1921. Actuals.	1922. Estimate.
	Rs.	Rs.	Rs.
Members' Subscriptions ..	9.000	9,309	9.000
Subscriptions for the Society's *Journal and Proceedings* and *Memoirs*	2.040	1,944	1.944
Sale of Publications ..	1.200	4,751	1,700
Interest on Investment ..	10,213	12,769	10,870
Rent of Room ..	650	600	650
Miscellaneous ..	100	142	100
Government Allowance—for publication of papers in *Journal*	2,000	2.000	2,000
Admission fees ..	..	656	..
TOTAL ..	25,203	32,171	26,264

Expenditure.

Salaries	7,758	7,998	8,502
Commission	600	618	600
Carried over ..			

	1921. Estimate.	1921. Actuals.	1922. Estimate.
	Rs.	Rs.	Rs.
Brought forward ..			
Stationery	150	153	150
Pension	180	180	180
Light and Fan ..	200	268	200
Taxes . ..	1,495	1,495	1,495
Postage	500	827	800
Freight	200	166	200
Contingencies ..	400	429	400
Books	600	1,200	800
Binding	600	643	600
Journal and Proceedings, and *Memoirs* ..	9,000	6,162	9,000
Indexes	200	..	200
Printing (Circulars, etc.) ..	500	427	500
Auditor's fee.. ..	250	250	250
Petty repairs ..	25	80	50
Insurance	344	344	344
Repairs	..	400	..
Summer clothing ..	..	94	..
Furniture	..	75	..
TOTAL ..	23,002	21,309	24,271

We therefore anticipate a saving of nearly Rs 2,000. Any expenditure for which provision has not been made might be met from the above surplus.

Library.

The total number of volumes and parts of magazines added to the Library during the year was 2,674, of which 303 were purchased and 2,371 were either presented or received in exchange.

During the war a large number of Societies Institutions, etc., ceased to despatch their publications to the Society. Every effort is being made to complete the Society's sets, and in return the Society is sending as far as available the *Journal and Proceedings* and *Memoirs* wanting from their sets.

Publications.

Five numbers of the *Journal and Proceedings* (Vol. XVI, 1920, Nos. 6-8 and Vol XVII, Nos. 1 and 2) were published during the year containing 423 pages and 6 plates in all

One number of the *Memoirs* was published, Vol VI, Part VII, containing 40 pages and 3 plates.

One Numismatic Supplement, No. XXXV, was published under the editorship of Mr. W. E. M. Campbell, I.C.S. in the Society's *Journal and Proceedings*, Vol. XVII, 1921, No. 1, containing 184 pages.

The Philological portions of the indices to the Society's *Journal and Proceedings*, Vols. XI–XIII, 1915-17 and the *Memoirs*, Vols III and V have now been examined by the Joint Philological Secretary and are being systematically arranged, and will be sent to press at an early date.

Exchange of Publications.

During the year the Council accepted six applications for exchange of publications, viz. from (1) The Department of Industries, Government of India—the Society's *Journal and Proceedings* and *Memoirs* in exchange with *Journal of Indian Industries and Labour*: (2) The Instituto General y Técnico de Valencia—the Society's *Journal and Proceedings* and *Memoirs* for their *Annals*; (3) The Editor of *Man in India* the Society's *Journal and Proceedings*, for their periodical; (4) The University Professor of Modern Indian History, Allahabad University—the Society's *Journal and Proceedings* and *Memoirs* for the *Journal of Indian History*; (5) The Corresponding Secretary, Glasgow University Oriental Society—the Society's *Journal and Proceedings* and *Memoirs* for their publications; (6) The Academy of Abo, Finland—the Society's *Journal and Proceedings* and *Memoirs* for their *Acta.*

Owing to increased cost of printing, the Yale University Press expressed its inability to continue the exchange of the *Journal of the American Oriental Society* for the publications of this Society, and the Council decided to subscribe to it.

The Department of the Interior, United States Geological Survey, Washington, having enquired whether it should supply to the Society copies of all new topographic maps published by the United States Geological Survey, in exchange for the publications of the Society, the Council decided that such maps were not required for its library.

Philology, etc.

Mr. W. Ivanow has contributed a paper entitled "Further Notes on Gypsies in Persia." It is supplementary to his paper "On the Language of the Gypsies of Qainat (in Eastern Persia)" (J.A.S.B. Vol. X, Nos. 10 and 11, 1914, pp. 439–455). It contains a vocabulary of about 100 words collected amongst the Gypsies of North-East Persia and is accompanied by notes on Gypsy Language, and also remarks on the conditions of their life in that country

Timur's Apocryphal Memoirs.— By H. Beveridge.

The works of Jean du Bec. and Sieur de Saynleon on Timur, alleged to be based on an Arabic original, are spurious The account of Timur by Abu Ṭālib al-Husaini is fictitious, Shah Jahan caused it to be harmonised with the Zafarnamah of Sharafu-d-din.

The premature death of Dr. L. P. Tessitori is a grievous loss to scholarship Vol. XVI, No. 6, of our *Journal* contains the last Progress Report of this young Italian scholar on the work done in 1918, in connection with the Bardic and Historical Survey of Rajputana. The report gives an account of the manuscripts he received or purchased in the territory of Bikaner, the works he edited and published for the State, and his antiquarian researches

Many other interesting papers have been contributed by Dr. R. C. Mujumdar, Mr. H. C Ray Chaudhuri, Mr. H. K. Deb and Mr N G. Majumdar. Perhaps the most important of these is "The Gupta Empire in the Sixth and Seventh Centuries" by Mr. Ray Chaudhuri In it an attempt has been made to give the general outlines of the history of the Gupta Empire from the death of Skandagupta to that of Jīvitagupta II.

Anthropology.

Only one paper of Anthropological interest has appeared in the *Journal and Proceedings* during the year, viz Mr. Hem Chandra Das-Gupta's paper *On the discovery of Neolothic Indian Script.* In this paper Mr Das Gupta contends that as the neoliths that are alleged to bear writing have not been found *in situ*, embedded in natural deposits, the markings on these neoliths do not prove that writing was known in India in Neolithic times.

Biology.

Four biological papers were published in the Society's *Journal*, and two in the *Memoirs*:—

Notes on Persistent Oviducts and Abnormal Testes in a Male *Rana tigrina*.—By D. R. Bhattacharya. Journal, Vol. XVI, No. 7.

Preliminary Observations on Cocoon-formation by the common Lahore Leech, *Limnatis* (*Poecilobdella*) *Granulosa* (Sav).—By G. Matthai. Journal, Vol. XVI, No. 8 .

Records of Agaricaceae from Bengal.—By S. R. Bose. Journal, Vol. XVI, No. 8.

The Genus *Cerebella* in India —By L. S. Subramaniam. Journal, Vol. XVII, No. 2.

Zoological Results of a Tour in the Far East —The Viviparous Water-Snail of Lake Biwa, Japan. By N. Annandale

Mysidacea, Tanaidecea, and Isopoda.—By W M. Tattersall.

Physical Science.

Two papers on Chemistry have been published by the Society during the year. The first of these is on the preparation of urea-antimonyl tartrate by Dr. U. N. Brahmachari When excess of solid urea is added to a very concentrated acqueous solution of hyper-acid-antimonyl tartrate, and the mixture concentrated by heating on the water bath, and then alcohol added to the mixture, crops of prismatic crystals are obtained This new compound is being used by Dr. Brahmachari in the treatment of kala-azar and its chemical properties are described in his paper.

The second paper dealing with the recent advances in stereochemistry by Prof. B. K. Singh was originally an address delivered by the author at the Nagpur Session of the Indian Science Congress. The subject of optical activity has furnished several important discoveries, which have materially contributed towards the development of modern chemistry and this forms the subject matter of the author's address which he discusses at some length.

Medical Section.

During 1921, three meetings of the Medical Section were held. Dr. U. N. Brahmachari, M.D., M.A., Ph D. F.A.S.B., read papers on "A new bracelet stethoscope for estimating systolic and diastolic blood pressures by the auscultatory method." and "On the treatment of malarial fever in individuals susceptible to attacks of blackwater fever by intravenous injections of an anti-haemolytic quinine solution." Dr. K. K. Chatterji read papers on "A modified Bassini method for the radical cure of hernia by plication and overlapping of the externus obliquus abdominis," and "On the radical cure of hydrocele by plication and overlapping of the tunica vaginalis" Major H. W. Acton, I.M.S., read a most interesting paper "On the Parasite-ridden Population of the Tropics," and Dr. J J. Campos one "On Chronic Lead Poisoning in the Printing Presses of Calcutta." A joint paper "On the Results of Treatment of Cholera at the Medical College Hospital, Calcutta," was contributed by Major F. P. Mackie, F.R.C.S., I.M.S., and Dr. J. C. Gupta, M.B. The Medical Section is now an important section of the Society's activities.

International Catalogue of Scientific Literature.

The Committee of the Royal Society in charge of the publication of the International Catalogue of Scientific Literature have decided owing to inadequate promise of financial support from different countries to stop the publication of the Catalogue after the volumes for 1914-1920 have been printed off, and have communicated their decision to the Society with a view to wind up this part of the Society's activity. The Government of India grant to the regional bureau was not sanctioned this year on account of the application made by the Society having been received by Government after the preparation of the budget. The part time clerk employed by the Society discontinued his work and no fresh appointment was made in his place.

Owing to the decision of the Royal Society to discontinue the publication of the Catalogue, no index slips in addition to those sent last year were forwarded to the Central Bureau during the year under report.

Bureau of Information.

There is nothing noteworthy in the work of this department. A few minor queries only were received.

Search for Sanskrit MSS.

The search for Sanskrit MSS. having been terminated by order of the Council, no purchases have been made during the year under review.

Three volumes of the Descriptive Catalogue of Sanskrit MSS. are in course of being printed Three Presses have been engaged. The Baptist Mission Press has printed off 736 pages, and set up about 200 pages more of the second volume on the Vedas. The Hare Press has set up 45 pages of the third volume on Smṛti In order to expedite publication, the Banerji Press has recently been engaged. It is hoped that the work will now make satisfactory progress.

Arabic and Persian Manuscript Search and Catalogue.

During the year 1921, nineteen Arabic and Persian MSS were purchased on behalf of Government

The First Travelling Maulavi was on leave throughout the year During his absence the work of the department was carried on by the Second and Third Travelling Maulavis and the two Additional Travelling Maulavis appointed on probation since Februay 1921. The Maulavis were engaged throughout the year in the preparation of notices on important Arabic and Persian MSS. in various parts of India These notices, prepared on the lines of those published in the J.A S B. (Vol. XIII, 1917, No. 2 and Vol XIV, 1918, No. 8) will shortly be ready for publication. They were also engaged in checking and examining the MSS. of the Government Collection and that of the A.S.B., and in the preparation of the Catalogue of MSS. in the Government Collection.

During the absence on leave of the Resident Maulvi, the

Acting First Travelling Maulavi was deputed to do his duties for about six months

Bibliotheca Indica.

Of the Akbaranāma of Abu'l-Faḍl—A history of the reign of Akbar including an account of his predecessors, translated from the Persian by Mr. H. Beveridge, I.C.S. (retired), Fasciculi XII and XIII were published.

Of the Odes of S̱ẖaykẖ Muslihu'd Dīn Sa'dī Shīrāzī. edited by Sir Lucas White King, Kt., C.S.I., LL.D., the second fasciculus of the first part (Ṭayyibāt), containing odes 154–312, was published.

Of the Muntakẖabu'l-Lubāb of Ḵẖāfī Ḵẖān—A general history of India from the Muhammadan conquest to the reign of Muḥammad S̱ẖāh, Emperor of Delhi, edited by Lieut.-Col. Sir T. W. Haig, K.C.I.E., I.S.C., M.R.A.S., the fifth fasciculus of the third part was printed off.

The non-Islamic publications have been as follows:—

(1) Śiva pariṇaya, a poem in the Kāśmīrī language, by Kṛiṣṇa Rājānaka (Rāzdān), with a Chāyā or gloss in Sanskrit by M.M. Mukundarāma Sāstrī. Fasc III. Edited by Sir George A. Grierson

(2) Yogaśastra,—A work on Jain Philosophy,—with the commentary called 'Svopajnavivarana' by Sri Hemachandrāchārya. Fasc. VI. Edited by Çāstravicarad Jainācārya Çrī Vijaya Dharma Sūrī.

(3) Sadukti-Karṇāmṛita. by Śrīdhara Dāsa. Fasc. II. Edited by Pandit Ramavatār Sarma, M.A.

(4) Nyāya-vārttika tātparya-pariśuddhi -- by Udayanāchārya,—with a gloss called Nyāya-nibandha-prakáśa, by Varddhamānopadhyaya. Fasc. VII. Edited by M.M. Paṇḍits Vindhyeśvari Prasad Dvivedin and Lakṣhmaṇ Śāstri Draviḍa.

(5) Kṛitya-ratnākara.—A treatise on Smṛiti by Chaṇḍeśvara Ṭhakkura. Fasc I. Edited by Pandit Kamal Kṛiṣṇa Smṛititirtha.

(6) Mahābhāṣyapradīpoddyota, or a commentary on Pāṇini Grammar. by Nāgeça Bhaṭṭa. Vol. IV. Fasc. IV and V. Edited by Pandit Bahuballabha Çāstri.

Coins.

During the year the work of Honorary Numismatist was again carried on by Mr. W. E. M. Campbell, I.C.S. During 1921, an important Numismatic Supplement, No. XXXV, was published. It contained seven valuable articles by Lt.-Colonel H. R. Nevill dealing with the coinage of the Sultans of Dehlī. In one of these the conception hitherto held in regard to the relationship between the Sultān Fīroz Shāh and Zafar Shah is shown to be fallacious, and the correct position and date of

Fīroz Shāh Zafar (his proper title) is demonstrated. Colonel Nevill has also discovered the coinage of a new Sultān, Mahmūd bin Sikandar Lodi. These seven articles with Major H. M. Whittell's "The Coins of Muhammad bin Tughlaq," give an exhaustive account of the coinage of Dehlī from the reign of Ghiyāsu-d dīn Tughlaq to the end of the so-called Pathan period. Another noteworthy contribution is Mr. F. D. J Paruck's Bibliography of Sāsānian Numismatics It is preceded by a short historical account of the study and investigation of this important series Professor S H. Hodivāla contributes two more of his interesting articles on the Mughal series, and there are two shorter notes, one by Mr C. E. Kotwall on a Bombay Half-Rupee of Charles II and the other on a seal of A'zam Shāh by Mr. R. B. Whitehead.

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Annual Address, 1921.

GENTLEMEN,

It is not incumbent on your President to deliver an address at the end of the first year of his term of office, and if I had decided to keep silent on the present occasion I could have cited weighty precedent in support of that course. I might also have justified my inaction on the ground that I have already had the privilege to address the Society at the annual meeting in recent years many more times than any other member. But I could not afford to forget that you did me signal honour, when you chose me your President for a second term, and I felt convinced that if I kept altogether silent, my attitude might be open to misconstruction. I trust I may accordingly rely upon your indulgent consideration this evening, while I attempt to supplement with a few observations of a general character the annual report which has been laid on the table, and make some reference to the progress of the work wherein we as a Society are interested, reserving for the next annual meeting a more comprehensive review of the subject

Let me invite your attention, in the first place. to what may be regarded as domestic matters During the last twelve months, our strength has been fairly maintained. and the slight diminution in the number of members need not give rise to serious misgivings. Amongst the members whose loss we lament, stand pre-eminent Babu Pratapchandra Ghose and Professor E. B. Tylor. An erudite scholar, the former was closely associated with the Society as an active member for a long series of years, and even in his retirement continued to edit for us valuable Buddhistic works in the Tibetan language. The latter was one of the most distinguished names in our roll of Honorary Fellows whose achievements are too well-known to require detailed statement here. Our finances also are in a sound and stable condition, and during the year about to commence, we anticipate that our solvency will be amply maintained. I emphasise this point, as our scheme for a new building is about to materialise. It is really a matter for congratulation that the doubt which at one stage was raised in official circles, as to the nature of our title to the present site which has been occupied by us for more than a century, has proved to be entirely illusory. We have at length secured from the Government of India a declaration that the land on which the present premises of the Society are erected must be regarded as the absolute property of the Society, subject to the payment of an annual rent which, however, is remitted while the Society actually occupies the land. This view renders it possible for us to raise the requisite funds by hypothecation of the land and the proposed buildings. I am hopeful that this work will be taken in hand without further delay, though I do not overlook the difficulties that will follow from the possible dislocation of existing arrangements during the period of construction; we have not yet been able to arrange for temporary accommodation elsewhere, and the problem does not at present appear to admit of an easy solution, as there is no prospect of help from the quarter where we had confidently looked for sympathetic treatment.

Let me pass on now to the work which engaged the attention of our members during the last twelve months. I venture to think that judged both by quantity and quality the outturn will be found creditable in every direction Take for instance, a glance at the antiquarian side Dr Rameschandra Majumdar discussed with much learning the history and chronology of the Imperial Gupta Dynasty after the death of Kumara Gupta the First, maintaining, contrary to the opinion of Mr. Radhagobinda Basak and Mr. Nalinikanta Bhattasali that the Kumara Gupta mentioned in the Saranath Inscription was the son and successor of Narasingha Gupta Mr. Panchanan Mitra investigated the interesting question of foreign affinities in prehistoric India, Central-Asian, Egyptian and Mediterranean, repudiating the theory of isolation with considerable force. Mr. Hemchandra Dasgupta cast doubt upon the alleged discovery of the existence of a script in India during neolithic times Mr. Nirmalchandra Chatterjee traced primogeniture as the general law of succession in ancient India in vedic times and attempted to show how it steadily gave way to the prevalent rule of equal distribution of property. Mr. Narendrakumar Majumdar, who has travelled all over India at the instance of the Calcutta University, in search of manuscripts of mathematical and astronomical treatises, gave an interesting account of the Manava Śulvasutra belonging to the Black Yajur Veda, which supplements, in a large measure, the corresponding works of the schools of Baudhayana and Apastamba. Mr. Kaye gave a note on the arrangement of the books of the Rig-veda. The study of inscriptions, on the other hand, attracted the attention of quite a number of scholars. Mr. Kisorimohan Gupta edited for the first time the Dhupi copperplate inscription which records a grant of land, by an Aryanised Synteng King of the Jaintia Hills, for the worship of the God Siva in the closing years of the eighteenth century. Mr. Haridas Mitra wrote on the newly discovered Bogra Stone Inscription which has been assigned to the tenth or even the ninth century on palæographic grounds. Mr. Nanigopal Majumdar, one of the youngest of our members, has to his credit the largest number of papers on antiquarian subjects. In one of his notes, he traced the existence of the term Gauda as early as the fourth century before the Christian era. In two other papers, he discussed the readings of three Kharosthi inscriptions, namely the Shakardara inscription of the year 40, the Mahaban inscription of the year 102, and the Loriyan Tangai inscription of the year 318. He also re edited the Sue Vihar copperplate which dates back to the eleventh year of the reign of Kaniska and was first edited by one of our past Presidents, the late Dr. Hoernle, from somewhat imperfect materials. In another paper, he edited the Maner copperplate of Gobindachandra which has an important bearing on the history of Bihar towards the close of the Pala rule. But the paper of Mr. Majumdar which attracted the most attention was that on the Andhau inscriptions of the Kshatrapa Dynasty, discovered by Prof. Bhandarkar in 1906. It is satisfactorily established that what was supposed to have been borrowed without acknowledgment from a paper by Prof. Lüders was in reality a well-known discovery of the late Pandit Bhagwanlal Indraji which no one could think of claiming as his own. Amongst other papers by some of the younger members of our Society may be mentioned one by Mr. Hemchandra Ray on Madra and another by Mr. Jyotischandra Ghatak on the identification of the plants Sarala and Devadaru so familiar to students of Indian literature. Of papers contributed by veteran members of the Society we are proud to welcome two which represent a good deal of laborious research, namely, one by Sir George Grierson on the Prakrita Dhatta Adesas and another by Mr. Pargiter on a vocabulary of current Bengali words not included in ordinary dictionaries. . Mr. Stapleton found time amidst pressing official duties to carry on his important researches on the History and Ethnology of North Eastern India, while Mr. Seth gave an account of the oldest Christian tomb with bi-lingual inscriptions, which stands in the Armenian cemetery at Agra. Mr. J. van Manen carried us beyond the limits of India and discoursed with characteristic erudition on Tibetan repartee songs and on the relation between the little known Bon religion of Tibet and Buddhism. Mr. Ivanow contributed an important paper on Ismailitica based on materials collected by him during his recent travels in Persia. Finally. we published the concluding instalment of the progress report of the work of Dr. Tessitori, the brilliant Italian scholar who was engaged on the Bardic and historical survey of Rajputana and whose premature death is a serious blow to the progress of research in an imperfectly explored department. When we turn for a moment to the activities of our members in branches of physical and natural science, we meet with a number of abstruse papers on Chemistry, Botany and Zoology; of these, the most interesting perhaps are the investigations on organic antimonial compounds by Dr. Brahmachari and his colleagues which are capable of practical applications of considerable importance.

I venture to hope that I shall not lay myself open to the charge of partiality towards our Society if I maintain that the activities of our members justify a hope that its reputation will be well-maintained in the future But 1 have heard it urged that we are no longer able to repeat the brilliant record of our earliest years. In this connection I would like to invite the attention of our critics to two outstanding circumstances. In the first place, the pioneers in a new field have opportunities of exploration and discovery which can scarcely if ever recur to their successors, however able and devoted. In the second place, what is perhaps of even greater importance, the lamp which was lighted by our illustrious founder more than a century ago has enabled others to light similar lamps elsewhere which must necessarily share with ours the glory of dispelling the darkness that envelopes the history of our past. During the last century societies and other institutions have sprung up in Europe and America, as also in Asiatic countries beyond the limits of India, where Ancient Indian History and Culture engage the attention of bands of enthusiastic students and investigators. Many of these institutions are maintained by the State; many again are supported by liberal aid from the public funds, while others flourish by reason of private munificence. It is not practicable for me within the limits of the time at my disposal this evening to touch upon the activities of all of them; but I may remind you of the creditable achievements of some at any rate amongst those that have advanced the cause of learning in this country Take for instance, the scientific departments of the Government of India, Archæological, Geological Zoological and Botanical, whose publications have attained a reputation not surpassed by that of similar publications in any civilised country. If we confine our attention to the Archæological survey alone, 'we find that besides the Annual Reports, distinct progress has been made with the Memoirs. In that series, the one which arrests attention forthwith is the memoir by Sir John Marshall on the excavations at Taxila, where he describes the Stupas and Monastery at Jaulian, incorporating a valuable contribution by Prof. Foucher on the decoration and evolution of the stuccoed stupas. In the same connection, we have the numismatic work of Mr. Whitehead and the study of Mr. Ramaprasad Chanda of the half-burnt manuscript of birch bark found in the monastery. When we turn to the Archæological survey of Burma, we come across a valuable monograph by Mr. Duroiselle on the Talain Plaques in the Ananda temple at Pagan, which was erected towards the end of the eleventh century and abounds in ornamentation of special importance, as well from the artistic as from the philological standpoint. The Epigraphia Indica continues to furnish most important materials for the reconstruction of Ancient Indian History, and one of the recent instalments where Mr. Yazdani deals with Indo-moslemic Epigraphy is full of interesting information relating to the Bijapur Kings. the Kutabsahi Kings of Hyderabad and the Khalji Sultans of Delhi If we travel further southwards we reach Travancore, where the archæological work commenced by the late Mr Gopinath Rao has been carried on vigorously by his successors; and we are now in possession of new information relating to Bauddha and Jaina vestiges in Travancore as also to the Vishnu temple at Tiruvalla If we leave aside for a moment state institutions, we find that good work has been in progress in the Bombay Asiatic Society, in the Behar and Orissa Research Society, in the Bhandarkar Institute at Poona and in the Mythic Society at Bangalore. Nearer home, the Library of Jaina literature has made rapid progress at Arrah, and the most important of the volumes recently published is the Bhadrabahu Samhita, which gives an authoritative account of Jaina jurisprudence. But the event of the year is the completion of the fiftieth volume of the Indian Antiquary which has, for half a century, been the recognised medium of communication of researches in every branch of oriental scholarship and constitutes a mine of invaluable information. If we pass on for a moment from the record of original investigations to the rescue and publication of oriental works, we cannot overlook that our activities in the Bibliotheca Indica Series have been supplemented in a striking manner by the several well-known series published in Bombay, Poona, Mysore, Trivandrum and Baroda, even if I leave for another occasion the splendid achievements for the promotion of investigation into our Vernaculars by the Bangiya Sahitya Parishad in this city and the Nagari Pracharini Sabha at Benares. Sanskrit works of supreme importance have thus been brought to light and placed in the hands of scholars in a reliable form. Let me refer as an illustration taken at random, to a recent volume of the Gaekwar Oriental Series, designated the Kavindracharya

Suchipatram. Kavindracharya was a famous South-Indian ascetic who lived at Benares in the middle of the seventeenth century and is still remembered for his eloquent pleading before the Emperor Shajahan in the Dewan-i-Am at Delhi. which deeply moved the Emperor and induced him to remit the obnoxious pilgrim tax levied in those days from pilgrims at Benares and Prayag. He had a famous library of manuscripts of inestimable value to all classes of scholars who came to Benares in search of knowledge, and the work now before us is a catalogue of those manuscripts, revealing to us the names of numerous treatises, which though in existence so recently as the end of the seventeenth century can no longer be traced

I have not yet however, turned your attention nearest home, because it is always darkest under the lamp. To my mind, the most hopeful augury for our future progress is the creation of living centres of oriental studies in connection with the Indian Universities, amongst whom the University of Calcutta has been the pioneer in this direction. During the last two years the University has published seven volumes of the Journal of Letters and several separate works which abound in important papers on Indian Antiquarian Research; and the most pleasant feature of the situation is that we have contributions not merely from veterans, but also from scholars on the threshold of their career, such as Dr. Rameschandra Majumdar, Dr. Benimadhab Barua, Mr. Panchanan Mitra, Mr. Pramathanath Banerjee, Mr. Nalinaksha Datta, Mr. Amareswar Thakur, Dr. Surendranath Sen, Mr. Praphullachandra Bose, Mr. Dhirendranath Mookerjee, Mr. Prabodhchandra Bagchi, Mr. Susilkumar Maitra, Dr. Hemchandra Raychaudhuri, Mr. Nanigopal Majumdar, Mr. Hemchandra Ray, Mr. Masuda and Mr. Kimura. They have proved themselves able and willing to enter the field along with scholars of established reputation like Prof. Bhandarkar, Mr. Herbert Bruce Hannah, Mr. Ramprasad Chanda, Mr. Haranchandra Chakladar, Mr. Kokileswar Sastri, Dr. Abhaykumar Guha, Mr. Saratchandra Mitra and Mr. Bijaychandra Majumdar. Many of the younger, like the older, scholars are members of our Society and have from time to time contributed papers which have been accepted by us for publication. The true significance of the appearance of a new generation of investigators, anxious to pursue research in the field of oriental antiquities, can hardly be mistaken, and we should all of us, without hesitation, welcome and encourage them in what we hope may prove to be their lifelong task. Our founder observed in ever-memorable words that this Society would flourish if naturalists, chemists, antiquaries, philologers and men of science in different parts of Asia would commit their observations to writing and send them to us; it would languish if such communications should be long intermitted, and it would die away if they should entirely cease. Let us be thankful to Providence that there is now not only no risk of even temporary intermission, much less of permanent interruption of the beneficent activities of this Society, but that, on the other hand, the scope of the work comprehended to be within its sphere by the genius of Sir William Jones has so vastly extended in amplitude and character that it is likely to provide engrossing occupation to devoted bands of investigators for generations to come.

The President announced the election of Officers and Members of Council for the year 1922 to be as follows :—

President.

The Hon'ble Justice Sir Asutosh Mookerjee, Kt., C.S.I., D.L., D.Sc., F.R.S.E., F.R.A.S., F.A.S B.

Vice-Presidents.

Mahamahopadhyaya Haraprasad Shastri, C.I.E., M.A., F.A.S.B.
P. J. Brühl, Esq., I.S.O., D.Sc., F.C.S., F.G.S., F.A.S.B.
L. L Fermor, Esq., O.B.E., A.R.S.M., D.Sc., F.G.S., F.A.S.B.
Upendra Nath Brahmachari, Esq., M.D., M.A., Ph.D , F.A.S.B.

Secretaries and Treasurer.

General Secretary :—W. A. K. Christie, Esq., B.Sc., Ph.D., F.A.S.B.
Treasurer :—W. R C. Brierley, Esq.
Philological Secretary :—Dr. Bhandarkar, Esq., M.A., F.A.S.B.
Joint Philological Secretary :—A. H. Harley Esq., M.A.
Natural History Secretaries:— Biology :—N. Annandale, Esq., D.Sc., C.M.Z.S . F.L.S., F.A.S.B.
Natural History Secretaries:— Physical Science :—E. P. Harrison, Esq., Ph.D., F. Inst. P., F.R.S.E.
Anthropological Secretary :—Ramaprasad Chanda, Esq., B.A.
Medical Secretary :—Major R. Knowles, I.M.S.
Honorary Librarian :—S. W. Kemp, Esq., B.A., D.Sc., F.A S.B.

Other Members of Council.

Sir R. N. Mookerjee, K.C.I.E.
P. C. Mahalanobis, Esq., B.Sc., M.A.
Kumar Sarat Kumar Roy, M.A.

A Suhrawardy, Esq, Iftikharul Millat, M.A.,Ph.D., F A.S.B., M.L.C, Bar-at-Law.
T. O. D. Dunn, Esq, M.A., D. Litt.
S Khuda Bukhsh, Esq., M A., B.C.L.

The President also announced the election of Fellows to be as follows:—

E. H. Pascoe, Esq., M.A., D.Sc, F.G S.
Ramaprasad Chanda, Esq., B.A.

The Meeting was then resolved into the Ordinary General Meeting

[APPENDIX.]

ABSTRACT STATEMENT

OF

RECEIPTS AND DISBURSEMENTS

OF THE

ASIATIC SOCIETY OF BENGAL

FOR

THE YEAR 1921.

STATEMENT

1921. *Asiatic Society*

Dr.

	Rs.	As.	P.	Rs.	As.	P.
To Establishment.						
Salaries	7,997	14	1			
Commission	618	5	9			
Pension	180	0	0			
				8,796	3	10
To Contingencies.						
Stationery	152	13	0			
Light and Fans	267	9	9			
Taxes	1,495	0	0			
Postage	827	3	0			
Freight	165	14	3			
Auditor's fee	250	0	0			
Petty Repairs	79	15	0			
Insurance	343	12	0			
Repairs	400	0	0			
Summer clothing	94	0	0			
Miscellaneous	429	0	11			
				4,505	3	11
To Library and Collections.						
Books	1,200	2	0			
Binding	643	8	0			
Furniture	75	5	3			
				1,918	15	3
To Publications.						
Journal and Proceedings, and Memoirs ..	6,162	0	9			
To printing charges of Circulars, etc. ..	427	2	0			
				6,589	2	9
To Personal Account (Written off)				503	8	4
Balance				2,14,171	0	4
Total Rs. ..				2,36,484	2	5

No. 1

of Bengal. *1921.*

Cr.

	Rs.	As.	P.	Rs.	As.	P.
By Balance from last Report				2,04,902	6	5
BY CASH RECEIPTS.						
Interest on Investments	12,768	8	4			
Publications sold for cash	117	6	0			
Rent of Room	600	0	0			
Government allowance—for publication of papers in Journal. (Anthropological Fund.)	2,000	0	0			
Miscellaneous	142	2	7			
				15,628	0	11
BY PERSONAL ACCOUNT.						
Members' Subscriptions	9,012	0	0			
Subscriptions to Journal and Proceedings, and Memoirs	1,968	0	0			
Admission Fees	656	0	0			
Sale on credit	4,159	9	1			
Miscellaneous	158	2	0			
				15,953	11	1
TOTAL Rs. ..				2,36,484	2	5

A. H. HARLEY,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

STATEMENT

1921. Barclay Memorial Fund in Account

From a sum of Rs. 500 odd given in 1896 by the Surgeon
couragement of Medical

Dr.

To Cash Expenditure.

	Rs. As. P.	Rs. As P.
Cost of Medal		12 10 0
To Balance—		
G.P. Notes (face value)	500 0 0	
Accumulated interest	92 3 8	
		592 3 8
Total Rs. ..		604 13 8

STATEMENT

1921. *Servants' Pension*

Founded in 1876 as the Piddington Pension Fund,

Dr.

	Rs. As. P.
Bank's Commission	0 4 0
Balance	1,662 7 10
Total Rs. ..	1,662 11 10

No. 2.

with the Asiatic Society of Bengal. *1921.*

General, I.M.S., for the foundation of a medal for the en-
and Biological Science.

Cr.

	Rs.	As.	P.	Rs.	As.	P.
By Balance from last Report—						
G.P. Notes (face value)	500	0	0			
Accumulated interest . ..	89	4	4			
				589	4	4
By Cash Receipt.						
Interest				15	9	4
Total Rs. ..				604	13	8

A. H. Harley,
Hon. Treasurer.

Calcutta, 31st December, 1921.

No. 3.

Fund *1921.*

with Rs. 500 odd from the Pidding Fund.

Cr.

	Rs.	As.	P.
By Balance from last Report	1,613	11	10
By Cash Receipt.			
Interest	49	0	0
Total Rs. ..	1,662	11	10

A. H. Harley.
Hon. Treasurer.

Calcutta, 31st December, 1921

STATEMENT

1921. Building

From a sum of Rs. 40,000 given by the Government of India to portion of the

Dr.

To Cash Expenditure.

	Rs. As. P.	Rs. As. P.
Bank's Commission	..	1 11 0
To Balance—		
G. P. Notes (face value)	40,000 0 0	
Treasury Bills (face value)	65,000 0 0	
Accumulated interest	17,443 12 0	
		1,22,443 12 0
Total Rs.	..	1,22,445 7 0

STATEMENT

1921. Bureau of Information in Account

From an annual grant of Rs. 1,200, made by the Govern-

Dr.

To Cash Expenditure.

	Rs. As. P.	Rs. As. P.
Government allowance (2 years' salary of Officer-in-charge) allotted for printing Notices of Sans. MSS.	2,400 0 0	
Salary	500 0 0	
		2,900 0 0
Balance	..	1,600 0 0
Total Rs.	..	4,500 0 0

No. 4.

Fund. *1921*

wards the rebuilding of the Society's Rooms, and from the sale of a Society's land.

Cr.

	Rs. As. P.	Rs. As P.
By Balance from last Report—		
G. P. Notes (face value)	40,000 0 0	
Treasury Bills (face value)	65,000 0 0	
Accumulated interest	12,797 2 0	
		1,17,797 2 0
By Cash Receipts		
Interest		4,648 5 0
TOTAL Rs. ..		1,22,445 7 0

A. H. HARLEY,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

No. 5.

with the Asiatic Society of Bengal. *1921.*

ment of Bengal for the salary of the Officer-in-Charge.

Cr.

	Rs. As. P.
By Balance from last Report	3,300 0 0
By Cash Receipt	
Government Allowance	1,200 0 0
TOTAL Rs. ..	4,500 0 0

A. H. HARLEY,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

STATEMENT

1921. *Anthropological Fund in Account*

This sum is set aside for the purchase of

Dr.

	Rs.	As	P.	Rs.	As.	P.
To Balance				968	4	3
Total Rs. ..				968	4	3

STATEMENT

1921. *International Catalogue of Scienti-* *Asiatic Society*

From the subscriptions of subscribers, and from a sum of incurred in connec-

Dr.

To Cash Expenditure.

	Rs.	As.	P.	Rs	As.	P.
Salaries	206	7	3			
Contingencies		4	0			
Postage	5	11	9			
Summer clothing	13	0	0			
				225	7	0
Balance				5,163	10	0
Total Rs. ..				5,389	1	0

No. 6.

with the Asiatic Society of Bengal. 1921.

Anthropological books from the balance of 1918.

Cr.

	Rs.	As.	P.
By Balance from last Report	968	4	3
TOTAL Rs. ..	968	4	3

A. H. HARLEY,
Hon Treasurer.

Calcutta, 31*st December,* 1921.

No. 7.

fic Literature in Account with the 1921.
of Bengal.

Rs 1,000 given by the Government of Bengal for expenses
tion with the Bureau.

Cr

	Rs.	As.	P.
By Balance from last Report	4,688	3	0
BY CASH RECEIPT.			
Subscriptions	700	14	0
TOTAL Rs ..	5,389	1	0

A. H HARLEY,
Hon. Treasurer.

Calcutta, 31*st December,* 1921.

STATEMENT

1921. Indian Science Congress in Account

From the subscriptions of

Dr.

To Cash Expenditure.

	Rs.	As.	P.	Rs.	As.	P.
Advance	600	0	0			
Contingencies	1,561	9	9			
Postage	227	6	0			
Printing	2,131	5	0			
Blocks	97	14	0			
Stationery	38	2	0			
Bonus	133	0	0			
Salary	25	0	0			
Light	200	0	0			
				5,014	4	9
Balance				1,362	6	7
Total Rs. ..				6,376	11	4

STATEMENT

1921. Oriental Publication Fund, No. 1, in

From a monthly grant made by the Government of Bengal for the publica-
(Rs. 500), and for the publication of Sanskrit

Dr.

To Cash Expenditure.

	Rs.	As.	P.	Rs.	As.	P.
Commission	69	2	0			
Editing Fees	576	0	0			
Salaries	2,424	8	5			
Contingencies	67	14	3			
Postage	215	1	6			
Stationery	16	0	0			
Printing	3,969	3	5			
Fan and Light	31	9	6			
Binding	25	4	0			
Summer Clothing	13	0	0			
				7,407	11	1
Personal Account (written-off)				232	9	6
Balance				50,743	14	7
Total Rs. ..				58,384	3	2

No. 8

with the Asiatic Society of Bengal. 1921.

members of the Congress.

Cr.

	Rs.	As.	P.	Rs.	As.	P.
By Balance from last Report				2,808	13	4
By Cash Receipts.						
Subscriptions, etc.	2,967	14	0			
Advance	600	0	0			
				3,567	14	0
Total Rs. ..				6,376	11	4

Calcutta, 31*st December*, 1921. A. H. Harley, *Hon. Treasurer.*

No. 9.

Acct. with the Asiatic Soc. of Bengal. 1921.

tion of Oriental Works and Works on Instruction in Eastern Languages
Works hitherto unpublished (Rs. 250).

Cr.

	Rs.	As.	P.	Rs.	As.	P.
By Balance from last Report				46,019	13	1
By Cash Receipts						
Government Allowance	9,000	0	0			
Sale of Publications	347	4	3			
Advances recovered	122	7	6			
				9,469	11	9
By Personal Account.						
Sale on credit				2,894	10	4
Total Rs. ..				58,384	3	2

Calcutta, 31*st December*, 1921. A. H. Harley, *Hon. Treasurer.*

STATEMENT

1921. Oriental Publication Fund, No. 2, in

From a monthly grant sanctioned up to March 1922, by the Government
Historical Interest

Dr

To Cash Expenditure.

		Rs. As. P	Rs.	As.	P
Printing Charges	..	..	2,322	4	0
Balance	..	..	18,989	9	0
Total Rs.		..	21,311	13	0

STATEMENT

1921 Sanscrit Manuscript Fund in Acct.

From an annual grant of Rs. 3,200 made by the Government of
cataloguing of Sanskrit Manuscripts acquired by
the same Government for the

Dr.

To Cash Expenditure.

	Rs.	As.	P.	Rs.	As.	P.
Salaries ..	3,045	4	3			
Contingencies	8	8	3			
Stationery	9	7	6			
Bonus ..	180	0	0			
Fan and Light	31	9	6			
Insurance	125	0	0			
Printing Charges	1,731	2	0			
Postage	40	14	0			
Summer Clothing	3	0	0			
				5,174	13	6
Balance				16,058	10	9
Total Rs. ..				21,233	8	3

No. 10.

Acct. with the Asiatic Soc. of Bengal. 1921

of Bengal of Rs 250 for the publication of Arabic and Persian Works of
(without remuneration).

Cr

	Rs.	As.	P.	Rs.	As.	P.
By Balance from last Report				18,311	13	0
By Cash Receipts.						
Government Allowance				3,000	0	0
Total Rs. ..				21,311	13	0

Calcutta, 31st December 1921.

A. H. Harley,
Hon Treasurer

No. 11

with the Asiatic Soc. of Bengal 1921.

Bengal and at present sanctioned to March 31,1923, for the
the Society for Government . and Rs. 2,400 from
salary of the Officer-in Charge

Cr.

	Rs	As.	P.	Rs.	As.	P
By Balance from last Report				13,209	6	3
By Cash Receipts.						
Govt Allowance for Sans. MSS. Preservation	3,200	0	0			
Govt. Allowance for Cataloguing ..	2,400	0	0			
Govt. Allowance (2 years' salary of Officer-in-Charge, allotted for printing Notices of Sans. MSS.)	2,400	0	0			
Sale of Publication	13	2	0			
				8,013	2	0
By Personal Account						
Sale on credit				11	0	0
Total Rs ..				21,233	8	3

Calcutta, 31st December, 1921.

A. H. Harley,
Hon. Treasurer

STATEMENT

1921. Arabic and Persian MSS. Fund in

From an annual grant of Rs. 5,000 made by the Government of India and
and binding of Arabic and Persian Manuscripts acquired by the
and for the preparation of notices of Arabic and Persian

Dr.

To Cash Expenditure.

	Rs.	As.	P.	Rs.	As.	P.
Salaries	4,614	9	9			
Purchase of Manuscripts	1,406	0	0			
Contingencies	5	2	3			
Stationery	17	13	0			
Postage	6	5	0			
Insurance	31	4	0			
				6,081	2	0
Balance				8,199	3	4
Total Rs. ..				14,280	5	4

STATEMENT

1921. Invest-

Dr.

	Face Value. Rs.	As.	P.	Cost. Rs.	As.	P.
To Balance from last Report	2,84,300	0	0	2,73,206	3	10
Total Rs.	2,84,300	0	0	2,73,206	3	10

Funds	Permanent Reserve. Face Value. Rs.	A.	P.	Permanent Reserve. Cost Rs.	A.	P.	Temporary Reserve. Face Value Rs.	A.	P.	Temporary Reserve. Cost. Rs.	A.	P.	Total Rs.	A.	P.
Asiatic Society ..	1,71,600	0	0	1,70,285	9	8	1,71,300	0	0	63,496	4	2	2,33,781	13	10
Building Fund ..		.					10,000	0	0	38,025	0	0	38,025	0	0
Servants' Pension Fund	1,400	0	0	1,399	6	0			.		.	.	1,399	6	0
Total Rs. ..	1,73,000	0	0	1,71,684	15	8	2,11,300	0	0	1,01,521	4	2	2,73,206	3	10

No. 12.

Acct. with the Asiatic Soc of Bengal. 1921.

sanctioned from April 1919 for another five years, for the cataloguing
Society for Government, for the purchase of further manuscripts,
manuscripts found in various libraries in India.

Cr

	Rs. As. P.	Rs. As. P.
By Balance from last Report		9,280 5 4
By Cash Receipts.		
Government Allowance		5,000 0 0
Total Rs. ..		14,280 5 4

A. H. Harley,
Hon. Treasurer

Calcutta, 31st December, 1921.

No. 13.

ment. 1921

Cr.

	Face Value. Rs. As. P.	Cost. Rs. As. P.
By Balance	2,84,300 0 0	2,73,206 3 10
Total Rs.	2,84,300 0 0	2,73,206 3 10

A. H. Harley,
Hon Treasurer.

Calcutta, 31*st December*, 1921.

STATEMENT

1921. *War*

Dr.

	Face Value.			Cost.		
	Rs.	As.	P.	Rs.	As.	P
To Balance from last Report	55,000	0	0	56,002	14	1
,, Purchase	30,000	0	0	30,690	13	9
TOTAL Rs.	85,000	0	0	86,693	11	10

STATEMENT

1921. *Treasury*

Dr.

	Face Value.			Cost.		
	Rs.	As.	P.	Rs	As.	P.
To Balance from last Report :—						
Bills for 12 months from 14th October, 1920	65,000	0	0	61,750	0	0
To Purchase :—						
Bills for 6 months from 29th October, 1921	65,000	0	0	63,862	8	0
TOTAL Rs.	1,30,000	0	0	1,25,612	8	0

No. 14.

Bond. *1921.*

Cr.

	Face Value. Rs.	As.	P.	Cost. Rs.	As.	P.
By Imperial Bank of India	5,000	0	0	**5,000**	**0**	**0**
By Balance	80,000	0	0	**81,693**	**11**	**10**
TOTAL Rs	85,000	0	0	**86,693**	**11**	**10**

A. H. HARLEY,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

No 15.

Bills. *1921.*

Cr.

	Face Value. Rs.	As.	P.	Cost. Rs.	As.	P.
By Imperial Bank of India	65,000	0	0	**61,750**	**0**	**0**
By Balance	65,000	0	0	**63,862**	**8**	**0**
TOTAL Rs.	1,30,000	0	0	**1,25,612**	**8**	**0**

A. H. HARLEY,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

STATEMENT

1921. *Personal*

Dr.

	Rs.	As.	P.	Rs.	As.	P.
To Balance from last Report				3,906	11	4
Advances for Postage, etc.				242	12	9
Asiatic Society	15,953	11	1			
Oriental Publication Fund, No. 1	2,894	10	4			
Sanskrit Manuscript Fund ..	11	0	0			
				18,859	5	5
TOTAL Rs. ..				23,008	13	6

STATEMENT

1921. *Fixed*

(Chartered Bank of India,

Dr.

	Rs.	As.	P.	Rs.	As.	P.
To Balance from last Report :—						
Principal £1,156-5-0				10,000	0	0
Interest £16-1-4				..		
TOTAL Rs. ..				10,000	0	0

No 16.

Account. *1921.*

Cr

	Rs.	As.	P.	Rs.	As.	P.
By Cash Receipts	..			19,028	9	4
,, Asiatic Society	503	8	4			
,, Oriental Publication Fund, No. 1 ..	232	9	6			
				736	1	10

By Balance.	Due to the Society.			Due by the Society.						
	Rs.	As.	P.	Rs	As.	P.		Rs.	As.	P.
Members ..	3,240	3	1	134	8	6				
Subscribers ..	..	.	.	70	11	0				
Surjdeo Pande (Bill Collector) ...	..	.	.	100	0	0				
Miscellaneous	567	3	..	258	0	3				
	3,807	6	1	563	3	9	..	3,244	2	4
Total Rs							..	23,008	13	6

A. H Harley,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

No. 17.

Deposit. *1921.*

Australia and China, London.)

Cr

	Rs.	As.	P.	Rs.	As.	P.
By Chartered Bank of India, Australia, and China (£92-14-9)	..			1,380	4	5
,, Balance (£1,138-19-2)	..			8,619	11	7
Total Rs.	..			10,000	0	0

A. H. Harley,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

STATEMENT

1921. ***Cash***

Dr.

	Rs.	As.	P.	Rs.	As.	P.
To Balance from last Report	..			18,623	5	7
,, Asiatic Society	15,628	0	11			
,, Barclay Memorial Fund	15	9	4			
,, Servants' Pension Fund	49	0	0			
,, Building Fund	4,648	5	0			
,, Bureau of Information	1,200	0	0			
,, International Catalogue of Scientific Literature	700	14	0			
,, Indian Science Congress	3,567	14	0			
,, Oriental Publication Fund, No. 1 .	9,469	11	9			
,, Do. do No. 2 .	3,000	0	0			
,, Sanskrit MSS. Fund	8,013	2	0			
,, Arabic and Persian MSS. Fund ..	5,000	0	0			
,, War Bond	5,000	0	0			
,, Treasury Bills	61,750	0	0			
,, Personal Account	19,028	9	4			
,, Fixed Deposit	1,380	4	5			
				1,38,451	6	9
TOTAL Rs. ..				1,57,074	12	4

STATEMENT

1921. ***Balance***

LIABILITIES.

	Rs.	As.	P.	Rs.	As.	P.
Asiatic Society	2,14,171	0	4			
Barclay Memorial Fund	592	3	8			
Servants' Pension Fund .. .	1,662	7	10			
Building Fund	1,22,443	12	0			
Bureau of Information	1,600	0	0			
Anthropological Fund	968	4	3			
International Catalogue of Scientific Literature	5,163	10	0			
Indian Science Congress	1,362	6	7			
Oriental Publication Fund, No. 1 ..	50,743	14	7			
Do. do. , No. 2 ..	18,989	9	0			
Sanskrit MSS. Fund.	16,058	10	9			
Arabic and Persian MSS. Fund ..	8,199	3	4			
				4,41,955	2	4
TOTAL Rs. ..				4,41,955	2	4

We have examined the above Balance Sheet and the appended detailed Accounts with the Books and Vouchers presented to us and certify that it is in accordance therewith correctly setting forth the position of the Society as at 31 December, 1921.

No. 18

Account. 1921.

Cr.

	Rs.	As.	P.	Rs.	As.	P.
By Asiatic Society	21,809	9	9			
,, Barclay Memorial Fund	12	10	0			
,, Servants' Pension Fund	0	4	0			
,, Building Fund	1	11	0			
,, Bureau of Information	2,900	0	0			
,, International Catalogue of Scientific Literature.	225	7	0			
,, Indian Science Congress	5,014	4	9			
,, Oriental Publication Fund, No. 1 ..	7,407	11	1			
,, Do. do. No. 2 ..	2,322	4	0			
,, Sanskrit MSS. Fund . ..	5,174	13	6			
,, Arabic and Persian MSS. Fund ..	6,081	2	0			
,, War Bond	30,690	13	9			
,, Treasury Bills	63,862	8	0			
,, Personal Account	242	12	9			
				1,45,745	15	7
By Balance				11,328	12	9
TOTAL Rs. ..				1,57,074	12	4

A H HARLEY,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

No. 19.

Sheet. 1921.

ASSETS.

	Rs.	As.	P.	Rs.	As.	P.
*Investments	2,73,206	3	10			
War Bills	81,693	11	10			
Treasury Bond	63,862	8	0			
Personal Account	3,244	2	4			
Fixed Deposit	8,619	11	7			
Cash Account	11,328	12	9			
				4,41,955	2	4
TOTAL Rs. ..				4,41,955	2	4

A. H. HARLEY,
Hon. Treasurer.

Calcutta, 31*st December*, 1921.

Liabilities up to 31st December, 1921.

FUNDS.

Asiatic Society	5,988	0	0
Oriental Publication Fund, No. 1	7,342	9	0
Do. do. , No. 2	4,244	7	0
Sans. MSS. Fund	3,926	7	0
TOTAL ..	21,501	7	0

Copy of Certified Statement of Securities in Custody of Bank of Bengal on account of Asiatic Society of Bengal, December 31, 1922:—

3½	per cent. Loan of 1842-43	16,700
3½	,, ,, ,, ,, 1854-55	1,54,100
3½	1865	44,300
3½	1879	8,000
3½	1900-1	51,100
*3	1896-97	500
4	Terminable Loan of 1915-16	10,100
6	per cent. Bonds, 1926	5,000
5¼	,, ,, War Bonds, 1928	75,000
Indian Treasury Bill	.. ..	65,000
	TOTAL Rs. ..	4,29,800

[* Cashier's security deposit.]

LIST OF MEMBERS

OF THE

ASIATIC SOCIETY OF BENGAL

ON THE 31ST DECEMBER 1921

LIST OF OFFICERS AND MEMBERS OF COUNCIL OF THE ASIATIC SOCIETY OF BENGAL FOR THE YEAR 1921.

—

President.

The Hon'ble Justice Sir Āsutosh Mukhopādhyāya Kt., C.S.I., D.L., D.Sc F.R.S.E., F.R.A.S., F.A.S.B.

Vice-Presidents.

Mahāmahopādhyaya Haraprasād Shāstri, C.I.E., M.A., F.A.S.B.
P. J. Brühl, Esq., I.S.O., D.Sc., F.C.S., F.G.S., F.A.S.B.
L. L. Fermor, Esq., O.B.E., A.R.S.M., D.Sc., F.G.S., F.A.S.B.
Lieut.-Col. D. McCay, M.D., F.R.C.P., F.A.S.B., I.M.S.

Secretaries and Treasurer.

General Secretary :—A. H. Harley, Esq., M.A.
Treasurer :—O. Martin, Esq.
Philological Secretary :—Dr. A. Suhrawardy, Iftikharul Millat M.A., F.A.S.B. (Bar-at-Law).
Joint Philological Secretary :—D. R. Bhandarkar, Esq., M.A. F.A.S.B.
Natural History Secretaries. { Biology :—S. W. Kemp, Esq., B.A., D.Sc F.A.S.B.
Physical Science :—S. K. Banerji, Esq., D.Sc
Anthropological Secretary :—Ramaprasad Chanda, Esq., B.A.
Medical Secretary :—Major R. Knowles, I.M.S.
Honorary Librarian :—W. A. K. Christie, Esq., B.Sc., Ph.D., F.A.S.B.

Other Members of Council.

Upendra Nath Brahmachari, Esq., M.D., M.A., Ph.D.
Ramesh Chandra Majumdar, Esq., M.A., Ph.D.
Sir R. N. Mookerjee, K.C.I.E.
G. E. Pilgrim, Esq., D.Sc., F.G.S.
P. C. Mahalanobis, Esq., B.Sc., M.A.
E. P. Harrison, Esq., Ph.D., F. Inst. P., F.R.S.E.

LIST OF ORDINARY MEMBERS.

R.=Resident. N R.=Non-Resident. A.=Absent. L M.=Life Member
F.M.=Foreign Member.

An Asterisk is prefixed to the names of the Fellows of the Society.

N.B.—Members who have changed their residence since the list was drawn up are requested to give intimation of such a change to the General Secretary, in order that the necessary alteration may be made in the subsequent edition. Errors or omissions in the following list should also be communicated to the General Secretary.

Members who are about to leave India and do not intend to return are particularly requested to notify to the General Secretary whether it is their desire to continue Members of the Society; otherwise, in accordance with Rule 40 of the rules, their names will be removed from the list at the expiration of three years from the time of their leaving India.

Date of Election		
1919 Feb. 5.	N.R.	Abdul Kader Surfraz. *Elphinstone College, Bombay*
1909 Mar. 3.	R	Abdul Latif, Khan Bahadur, Syed, Under-Secretary, Government of Bengal Revenue Dept. *Calcutta.*
1894 Sept. 27.	L.M.	Abdul Wali, Khan Sahib. 3 *Alimuddin Street, Calcutta.*
1915 Feb. 3.	N.R	Ahmad Ali Khan, Hafiz, Superintendent Rampur State Library. *Rampur.*
1903 Oct. 28.	R.	Allan, Alexander Smith, M.B. 17 & 18, *Esplanade Mansions*
1919 July 2.	R.	Amin-ul-Islam, Khan Bahadur Nawabzada, B.L. *Inspector General of Registration, Bengal.*
1912 July 3.	N.R.	Andrews, Egbert Arthur, B.A. *Tooklai Experimental Station, Cinnenara P.O., Jorhat, Assam.*
1904 Sept. 28.	L.M.	*Annandale, Nelson, D.Sc., C.M.Z.S., F.L.S., F.A.S.B., Director, Zoological Survey of India. *Calcutta.*
1911 May 3.	R.	Atkinson, Albert Charles. *La Martinière, 11, Loudon Street, Calcutta.*
1904 July 6.	N.R.	Aulad Hasan, Khan Bahadur Sayid. [*Dacca,*
1917 April 4.	N.R.	Awati, P. R., M.A., Medical Entomologist Central Research Institute. *Kasauli.*

Date of Election		
1914 Mar. 4.	L.M.	Bacot, J. 31, *Quai d'Orsay, Paris.*
1870 Feb. 2.	L.M.	Baden-Powell, Baden Henry, M.A., C.I.E. *Ferlys Lodge.* 29, *Banbury Road, Oxford. England.*
1919 April 2.	R.	Bal, Surendra Nath 44, *Ritchie Road, Ballygunge, Calcutta.*
1918 April 3	N.R.	Ballabhdas, Dewan Bahadur, Banker and Zemindar. *Jubbulpur.*
1920 Mar. 3.	R.	Ballardie, J. H. de Caynoth. 1 1, *Vansittart Row, Calcutta.*
1905 Mar. 1.	R.	Banerji, Muralidhar. *Sanskrit College, Calcutta.*
1918 Feb 6	N.R.	Banerji, Narendra Nath. Supdt of Telegraphs. *Nagpur.*
1919 July 2.	R.	Banerji, Pramathanath, M.A., D.Sc. *Calcutta University, Calcutta.*
1919 July 2.	R	Banerji, Pramathanath M.A., B.L., Vakil, High Court. *Calcutta.*
1907 Jan. 2.	N.R.	Banerji, Rakhal Das. M.A., Supdt., Archæological Survey Western Circle. *Poona.*
1918 Dec. 4.	R.	Banerji, Sudhangsu Kumar. Ghose Prof. of Applied Mathematics. Calcutta University. *Calcutta.*
1885 Nov. 4.	R.	Barman, Damodar Das. 55, *Clive Street, Calcutta.*
1898 Mar. 2	N.R.	Barnes, Herbert Charles. M.A., I.C.S., Deputy Commissioner. Naga Hills *Kohima, Assam*
1909 July 7.	N.R.	Bazuz. Rangnath Khunraj *Girgaon Bombay.*
1895 July 3.	L.M.	Beatson-Bell The Hon. Sir Nicholas Dodd, B.A., C.I.E., I.C.S., Chief Commissioner of Assam *Shillong.*
1907 Feb. 6.	N.R.	Bell, Charles Alfred, C.M.G., I.C.S *The Elms, Darjeeling.*
1915 April 7.	N.R	Belvalkar, Sripad Krishna, M.A., Ph.D., Prof. of Sanskrit, Deccan College. *Poona.*
1909 April 7.	R.	Bentley. Charles A., M.B, D.P.H. *Writers' Building, Calcutta.*
1876 Nov. 15.	F.M.	*Beveridge, Henry, F.A.S.B., I.C.S. (retired). 53, *Campden House Road, W. 8, London.*
1917 Aug. 1.	R.	*Bhandarkar, Devadatta Ramkrishna, M.A. 35 *Circular Road, Ballygunge.*
1908 Nov. 4.	R.	Bhattacharji, Bisvesvar. 22, *Vidyasagar, Street Calcutta.*

Date of Election.		
1909 July 7.	R.	Bhattacharji, Shib Nath, M.B. 80, *Shambazar Street Calcutta.*
1893 Feb. 1.	L.M.	Bodding, Revd P. O. *Dumka, Sonthal Parganas.*
1912 July 3.	R.	Bomford, Capt. Trevor Lawrence, I.M.S., M.B., B.S., M R.C.S , L.R.C.P. *Eden Hospital, Calcutta.*
1898 Feb. 2.	R.	Bose, Amrita Lal, Dramatist. 9-2, *Ram Chandra Maitra's Lane, Calcutta.*
1918 July 3	R.	Bose, Charu Chandra, Asst. Surgeon, Medical College. 52 2, *Mirzapur St., Calcutta.*
1895 Mar. 6.	R.	*Bose, Sir Jagadis Chandra, Kt., C.S.I., M.A., D.Sc , C.I.E., F.A.S.B. *Presidency College, Calcutta.*
1919 Jun. 6.	R	Bose, Ojit Mohan, M B , Ch.B (*Edin*). 191, *Bow Bazar Street, Calcutta.*
1917 Oct. 3	N.R.	Bose, Satyendra Nath, M.Sc. *University College of Science, Calcutta.*
1910 July 6.	N.R.	Botham, Arthur William, I.C.S. *Shillong.*
1908 Jan 1.	R.	Brahmachari, Upendra Nath, M.A . Ph D., M.D. 82/3, *Cornwallis Street, Calcutta.*
1920 Sep 1	N.R.	Brandon, Major, F. G. *Indian Army, 52nd Sikh's, F.F. Jullundar.*
1921 Nov. 2	R.	Brierly, W. R C 41, *Bankshall Street, Calcutta.*
1907 July 3.	A.	*Brown, John Coggin, F.G.S., M.Sc., F.C.S , Europe (*c o Geological Survey of India Calcutta*).
1909 Oct 6.	R.	Brown, Percy, A.R.C.A *Government School of Art, Calcutta.*
1909 Oct 6	R.	*Brühl, Paul Johannes, I.S.O., D.Sc., F.C.S , F.G.S., F.A.S.B. 35, *Ballygunge Circular Road, Calcutta*
1901 June 5	F.M	*Burkill, Isaac Henry, M.A., F.A.S.B. *Botanical Gardens, Singapur.*
1896 Jan. 8.	A.	*Burn, Richard, C.I.E., I.C.S., F.A.S B
1900 May 2.	N.R	Butcher, Flora, M.D. *Nanda View Cottage, Ranikhet, U. P.*
1913 Apl 2.	R.	Calder, Charles Cumming. *Royal Botanic Gardens, Sibpur, Howrah.*
1901 Mar. 6.	N.R.	Campbell, William Edgar Marmaduke, I.C.S., Commissioner Benares Division. *Benares.*
1918 June 5.	A.	Campbell, Major W. L , I.A *Europe (c/o India Office)*
1918 July 3.	R.	Campos, Joachim Joseph, M.B. 16 2, *Royd Street, Calcutta.*

Date of Election.		
1915 Jan. 6.	A.	Carter, Humphry G., M.B., Ch.B., Economic Botanist to the Botanical Survey, Indian Museum. 27, *Chowringhee Road, Calcutta.*
1920 Sep. 1.	R.	Chatterjee, Nirmal Chandra. 52, *Haris Mukerjee Road, Bhowanipore, Calcutta.*
1909 Mar. 3.	R.	Chakravarti, Nilmani, M.A. *Presidency College, Calcutta.*
1905 July 5.	N.R.	Chakravarti, Vanamali. *Cotton College.* [*Gauhati.*
1920 Sept. 1.	R.	Chanda, Ramaprasad, B.A. 37*A*, *Police Hospital Road, Calcutta.*
1906 Jan. 3.	R.	Chapman, John Alexander. *Europe* (*c/o Imperial Library, Calcutta*).
1915 Oct. 27.	N.R	Chatterjee, Atul Chandra, I.C.S. *Lucknow*
1911 June 7.	R.	Chatterjee, Karuna Kumar, F.R.C S. 74, *Dharamtola Street, Calcutta.*
1916 Jan. 5.	R.	Chatterjee Khagendra Nath, B.A., B.L., Attorney-at-Law. 12, *Madan Mohan Chatterjee Lane, Calcutta.*
1920 Sept 1.	R.	Chakladar Haran Chandra. 28/4, *Sahanagar Lane, Kalighat, Calcutta.*
1907 Sept. 25.	R.	Chatterjee, Promode Prakas. 8, *Dixon Lane, Calcutta.*
1893 Sept 28.	R.	Chaudhuri, B L., B A., D.Sc. (Edin.), F.R.S.E., F.L S. (Lond.). 120, *Lower Circular Road, Calcutta.*
1914 April 1.	R.	Chaudhuri. Gopal Das. 32, *Beadon Row,* [*Calcutta.*
1907 July 3	R.	*Christie, William Alexander Kynoch, B.Sc., Ph.D., F.A.S.B. *Geological Survey of India, Calcutta*
1909 Nov 3.	N.R	*Christophers, Major Samuel Richmond, M.B., F.A S.B, I M.S *Research Laboratory, Kasauli.*
1906 Nov. 7.	N.R.	Clarke, Geoffrey Roth, I.C.S., Director General, Posts and Telegraphs. *Simla.*
1915 Sept. 1.	R.	Cleghorn, Maude Lina West, F.L.S., F.E S. 12. *Alipur Road, Calcutta.*
1920 Dec. 1.	R.	Connor, Lieut.-Col. F. P. No. 2, *Upper Wood Street, Calcutta.*
1907 July 3.	N R.	Cotter, Gerald de Purcell, B A., F.G.S. *Europe* (*c/o Geological Survey of India*).
1887 Aug. 25	R.	Criper, William Risdon, F.C.S., F.I.C., A.R.S.M. *Konnagar, E.I.R.*
1873 Dec. 3.	F.M.	Dames, Mansel Longworth, I.C.S. (retired). *Ventnor, Wodeland Road, Guildford, Surrey, England.*

Date of Election.		
1918 April 3	N R.	Das, Jagannath, Ratnakar, B.A., Private Secy. to Srimati Maharani of Ajodhya. *The Rajsadan, Ajodhya.*
1915 Sept. 1.	R.	Das-Gupta, Hem Chandra, M.A., F.G.S., Prof., Presidency College. *Calcutta.*
1917 April 4.	R.	Datta, Rasik Lal, D.Sc., F.C.S., F.R.S.E., Industrial Chemist, Dept. of Industries, Bengal. 78, *Manicktola St., Calcutta.*
1910 Jan 5.	R.	David, David A. 55, *Free School St., Calcutta.*
1895 Sept. 19.	N R.	De, Kiran Chandra, B.A., I.C.S., Commissioner. *Chittagong.*
1917 June 6.	R.	Deb, Kumar Harit Krishna, M.A., Zemindar, Sobhabazar Rajbati. *Raja Navakrishna St., Calcutta.*
1921 Sept. 7.		Deb, Profulla Krishna, Zemindar and Landlord. 106/1, *Grey Street, Calcutta.*
1904 Sept. 28.	N.R.	De Courcy, William Blennerhasset. *Leddlesdale Estate, Naduwatum P.O., Nilgiris.*
1906 Dec. 5.	N.R.	Dentith, Arthur William, I.C.S. *Shillong.*
1910 May 4.	L.M.	Dhavle, Sankara Balaji, I.C.S. *Ranchi.*
1907 Oct. 30.	N.R.	Dixit, Sri Ram, B.A. *Dewan of Banswara, Rajputana.*
1920 Aug. 4.	R.	Dikshit, K. N. *Offg. Supdt., Archæological Survey, Eastern Circle, Calcutta.*
1898 Jan 5.	R.	Dods, William Kane, Agent, Hongkong and Shanghai Banking Corporation. *Calcutta.*
1919 Nov 5.	N.R.	Dube, Babool Mayeshanker. *R. N. High School, Fathpur (Jaipur).*
1909 Nov. 3.	A.	*Donovan, Lieut.-Col. Charles, M.D., I.M.S., F.A.S.B. *Europe* (*c/o Medical College, Madras*).
1902 July 2.	R.	Doxey, Frederick. 63, *Park Street, Calcutta.*
1909 Aug. 4.	N.R.	Drake-Brockman, Digby Livingstone, I.C.S. *Saharanpur, U.P.*
1917 June 6	R.	Dunn, T. O. D. *Europe* (*c/o Education Dept., Bengal*).
1914 Sept. 2.	R.	Dutt, B. C. 172, *Manicktola Street, Calcutta.*
1920 April 7.	R.	Dutt, Kumar Krishna. 10, *Hastings Street, Calcutta.*
1910 April 6.	R.	Elmes, Dr. Cecil H. *Harrington Mansion, Calcutta.*
1911 Nov. 1.	A.	Esch, V. J., Architect. *Victoria Memorial Building, Cathedral Avenue, Maidan, Calcutta.*

Date of Election.		
1904 Aug. 3.	R.	*Fermor, Lewis Leigh, A.R.S.M., D.Sc., F.G.S., F.A.S.B. *Geological Survey of India, Calcutta.*
1906 Oct. 31.	N.R.	Finlow, Robert Steel, Fibre Expert and Dir. of Agri. *Dacca.*
1913 Nov. 5.	R.	Fox, Cyril S., B.Sc., M.I.M.E., F.G.S. *Geological Survey of India, Calcutta.*
1919 April 2.	N.R.	Friel, R., I.C.S. *Jorhat, Assam.*
1903 Mar. 4.	R.	*Gage, Lieut.-Col. Andrew Thomas, M.A., M.B., B.Sc., F.L.S., F.A.S.B., I.M.S. *Europe (c/o Royal Bot. Gardens, Howrah).*
1919 Feb. 5.	F.M.	Galoostian, V. M. (*Sanger, California*)
1919 Nov. 5.	N.R.	Gambhir, J. S. *Shamaldas College, Bhavnagar, Kathiawar.*
1912 Mar. 6.	R.	Ganguli, Manmohan, B.E. 50, *Raja Rajballev Street, Calcutta.*
1909 Oct. 7.	R.	Ganguli, Ordhendhu Kumar 12, *Ganguli's Lane, Calcutta.*
1920 Mar. 3.	N.R.	Ganguli, Capt. P., I.M.S. *Rawalpindi.*
1921 June 1.	R.	Ghatak, Prof. Jyotischandra. 5, *Boloram Bose Ghat Lane, Bhowanipore.*
1905 July 5.	R.	Ghosh, Amulya Charan, Vidyabhusana. 82, *Manicktolla Street, Calcutta.*
1912 Aug. 7.	R.	Ghosh, Atal Behari, M.A., B.L. 59, *Sukea Street, Calcutta.*
1918 Feb. 6.	R.	Ghosh, Ekendra Nath, M.D., M.Sc., Prof. of Biology. *Medical College, Calcutta.*
1907 Mar. 6.	R.	Ghosh, Prafulla Chundra, M.A. *Presidency College, Calcutta.*
1920 May 5.	R.	Ghosh, Sukhendro Nath, B.A., B.Sc. 117, *Dharamtollah Street, Calcutta.*
1912 Sept. 4.	R.	Ghosh, Tarapada. 14, *Paddapuker Street, Kidderpur, Calcutta.*
1919 Feb. 5.	N.R.	Ghulam Mohiud-din Sufi. *Normal School Amraoti.*
1920 July 7.	A.	Gourlay, Major C A., I.M.S. *Presidency General Hospital, Calcutta.*
1909 Jan. 6.	R.	Gourlay, William Robert, C.I.E., I.C.S. *Govt. House, Calcutta.*
1910 Sept. 7.	N.R.	*Gravely, Frederic Henry, D.Sc., F.A.S.B. *Govt. Central Museum, Madras.*
1905 May 3.	F.M.	Graves, Henry George, A.R.S.M. 52, *Cradington Road, Bedford, England.*
1910 Mar. 2.	N.R.	*Greig, Major Edward David Wilson, M.B., F.A.S.B., I.M.S. *Simla.*
1900 Dec. 5.	L.M.	Grieve, James Wyndham Alleyne, *c/o Messrs. Coutts & Co*, 440, *Strand, London, W C. 2.*

Date of Election.		
1917 June 6	N.R.	Gupta, Kisorimohan, M.A., Prof. of History, M.C. College. *Sylhet, Assam.*
1919 Mar. 5.	N.R.	Gupta, Siva Prasad. *Satyaupavana, Benares City.*
1915 Aug. 4	R.	Gurner, C. W., I.C.S. 12, *Store Road, Ballygunge, Calcutta.*
1901 Mar. 6.	N.R.	Habibur Rahman Khan. Raees. *Bhikanpur, District Aligarh.*
1892 Jan 6.	F.M.	Haig, Lieut.-Col. T. Wolseley, C.M.G., Indian Army, H.B.M.'s Legation. *Tehran, Persia.*
1907 Aug. 7.	N.R.	*Haines, Henry Haselfoot, F.C.H., F.L.S., F.A.S.B. *Europe.*
1908 June 3.	A	Hallowes, Kenneth Alexander Knight, B.A., A.R.S.M., F.G.S., Assistant Superintendent, Geological Survey of India *Calcutta.*
1916 Jan. 5.	N.R.	Hamilton, C. J. *Patna University, Patna*
1913 May 7.	N.R.	Hankin, E. H., M.A., D.Sc. *Chemical Examiner, Agra.*
1885 Feb. 4.	L.M.	*Haraprasad Shastri, Mahamahopadhyaya, C.I.E., M.A., F.A.S.B. 26, *Pataldanga Street, Calcutta.*
1920 May 5.	N.R.	Harcourt, Major E. S. *United Service Club, Calcutta.*
1912 May 1.	R.	Harley, A. H., M.A. *The Madrasah. Calcutta.*
1908 April 1	R.	Harrison, Edward Philip, Ph.D., F.R.S.E. *The Observatory, Alipur, Calcutta.*
1921 May 4.	N.R.	Hartog, P. J. Vice-Chancellor, Dacca University. *Ramna, Dacca.*
1897 Feb. 3.	F.M.	*Hayden, Sir Henry Herbert, Kt., C.I.E., D.Sc., B.A., B.E., B.A.I., F.G.S., F.A.S.B. *Oriental Club, Hanover Square, London.*
1911 June 7.	R.	Hedayat Husain, Shams-ul-Ulama Muhammad. 7-1, *Ramsanker Roy's Lane, Calcutta.*
1919 Nov. 5	N.R.	Hemraj, Raj Guru *Dhokatol, Nepal.*
1908 June 3.	R.	Heron, Alexander, Macmillan, D.Sc., F.G.S., Assoc. Inst. C.E. *Geological Survey of India, Calcutta.*
1920 Feb. 4.	N.R.	Hill, H. B. C. *P.O. Chabna.* [*Damoh, C.P.*
1911 April 5.	N.R.	Hiralal, Rai Bahadur, B.A., M.R.A.S.
1891 July 1.	F.M.	*Holland, Sir Thomas Henry, K.C.S.I., K.C.I.E., D.Sc., A.R.C.S., F.R.S., F.G.S., F.A.S.B., President, Indian Munitions Board. *Simla.*

Date of Election		
1910 Jan. 5.	A.	Hope, Geoffrey D., B.Sc , Ph.D *Europe (c/o Indian Tea Association)*
1921 Nov. 2	R.	Hora Sunder Lall. *Zoological Survey of India. Indian Museum, Calcutta.*
1873 Jan. 2.	L.M.	Houstoun, George L., F.G.S. *Johnstone Castle, Renfrewshire, Scotland.*
1918 Feb. 6.	R.	Hui, Rev. Sramana Wan 4, *Tiretta Bazar Street, Calcutta.*
1911 Feb. 1.	R.	Insch, Jas. *Europe (c o Messrs. Duncan Bros., Calcutta).*
1920 Dec. 1	R.	Ivanow, W. 77, *Elliott Road, Calcutta.*
1916 Jan. 5.	N.R	Jain, Kumar Devendra Prasad, Secy. All-India Jain Association. *Arrah.*
1921 Feb. 2.	R.	Jain, Chhoti Lall, M.R.A.S. 53/1, *Burtolla Street, Calcutta.*
1907 Sept. 25.	N.R.	Jenkins, Owen Francis, I.C.S. *Badaun.*
1908 June 3.	R.	Jones, Herbert Cecil, A.R.S.M., A.R.C.S., F.G.S. Assistant Superintendent, Geological Survey of India. *Calcutta*
1911 Sept. 1.	N.R.	Juggarao, Sree Raja Ankitam Venkata. Zemindar of Shermahamadpuram. *Daba-gardens, Vizagapatam.*
1911 Nov. 1.	N.R.	Kamaluddin Ahmed, Shams-ul-Ulama. *The University, Lucknow.*
1891 Feb. 4.	N.R.	Kapur, Raja Ban Behari, C.S.I. *Burdwan.*
1920 Feb. 4.	R.	Keir, W. I., Asst. Architect to the Govt. of Bengal. *Writers' Building Calcutta.*
1910 May 4.	R.	*Kemp, Stanley W., B.A., D.Sc., F.A.S.B 27, *Chowringhee Road, Calcutta.*
1882 Mar. 1.	N.R.	Kennedy, Pringle. M.A., B.L. *Mozafferpur.*
1920 Mar. 3.	R.	Khuda Bakhsh, S., Bar-at-Law. 5, *Elliott Road, Calcutta.*
1909 April 7.	R.	Kilner, John Newport, M.B., L.R.C.S., L.R.C.P. 14, *Garden Reach, Calcutta.*
1920 July 7.	R.	Kar, Sites Chandra. 47, *Corporation Street, Calcutta.*
1920 July 7	R.	Knowles, Major R. 63, *Park Street, Calcutta.*
1910 Mar. 2.	R.	Kirkpatrick, W. *Chartered Bank Buildings, Calcutta.*
1921 Dec. 7.	N.R.	Kumar, Anand Kumar. *Fairfield, Firozepore Road, Lahore.*
1920 Mar. 3.	R.	Lahiri, Jagadindranath. 91, *Upper Circular Road, Calcutta.*

Date of Election.		
1887 May 4.	L.M.	Lanman, Charles Rockwell. 9, *Farrar Street, Cambridge, Massachusetts, U.S. America.*
1919 Nov. 5.	R	Larmour, F. A. 60, *Bentinck Street, Calcutta.*
1889 Mar. 6.	L.M.	*La Touche, Thomas Henry Digges, B.A., F.G.S., F.A.S.B. *Alfriston Hills Road, Cambridge, England.*
1914 Aug. 5.	R.	Law, Bimala Charan, B.A. 24, *Sukea St., Calcutta.*
1921 July 6.	R.	Law, Netai Charan. 56, *Sukea Street, Calcutta.*
1911 Feb. 1.	R.	Law, Narendra Nath, M.A., B.L. 96, *Amherst St., Calcutta.*
1914 July 1.	R.	Law, Satya Charan, M.A., B.L. 24, *Sukea St., Calcutta.*
1902 July 2.	N.R.	Leake, Henry Martin, M.A., F.L.S. *Nawabgunj, Cawnpore.*
1918 June 5.	N.R.	Lees, Donald Hector, I.C.S. *Jalpaiguri.*
1911 May 3.	R.	Lomax, C. E., M.A. *La Martinière, Calcutta.*
1906 Oct. 31.	N.R.	Luard, Lieut.-Col. Charles Eckford, M.A. (Oxon), Indian Army. *Sehore, C.P.*
1870 April 7.	L.M.	Lyman, B. Smith. 708, *Locust Street, Philadelphia, U.S. America.*
1893 Jan. 11.	L.M.	Maclagan, The Hon. Sir Edward Douglas, M.A., K.C.I.E., C.S.I., I.C.S., Lieutenant-Governor of the Punjab. *Lahore.*
1905 Aug. 2.	R.	*McCay, Lieut.-Col. David, M.D., F.A.S.B., I.M.S. 15, *Kyd Street, Calcutta.*
1913 Mar. 5.	N.R.	MacMahon, P. S., M.Sc. B.Sc. *Canning College, Lucknow.*
1893 Jan. 11.	L.M.	Madho Rao Scindia, His Highness Maharajah Colonel Sir, Alijah Bahadur, G.C.S.I., G.C.V.O., A.D.C., LL.D., Maharajah of Gwalior. *Jai Bilas, Gwalior.*
1916 June 7.	N.R.	Mahajan, Surya Prasad. *Murarpur, Gaya.*
1920 Mar. 3.	R.	Mahalanobis, Prof. P. C., B.Sc., M.A. 210, *Cornwallis Street, Calcutta.*
1906 Dec. 5.	R.	Mahalanobis, Subodh Chandra, B.Sc., F.R.S.E., F.R.M.S. 210, *Cornwallis Street, Calcutta.*
1911 Mar. 1.	R.	Mahatap, The Hon. Sir Bijoy Chand, K.C.S.I., Maharajadhiraj of Burdwan. 6, *Alipur Lane, Calcutta.*
1918 Aug. 7.	R.	Maitra, Jatindra Nath, Physician and Surgeon. 68/*A, Beadon St., Calcutta.*

Date of Election.		
1918 Feb. 6.	N.R.	Maitra, Sisir Kumar, Principal, Indian Institute of Philosophy. *Amalner, Bombay Presidency.*
1920 June 2.	R.	Majumdar, N. G. 70, *Russa Road, North, Calcutta.*
1916 Feb. 2.	R.	Majumdar, Narendra Kumar, M.A., Asst. Prof. Calcutta University. *Calcutta.*
1912 Jan. 10.	N.R.	Majumdar, Rai Jadunath, Bahadur, Government Pleader. *Jessore.*
1913 June 4.	N.R.	Majumdar, Ramesh Chandra, M.A., Ph.D 16, *Chandranath Chatterji Street, Bhowanipur, Calcutta.*
1918 Feb. 6.	R.	Manen. Johan van, Off. Librarian, Imperial Library. *Calcutta.*
1920 Jan. 5.	N.R.	Mangalik, Murari Sharan, Editor, " The Lalita." *Sivasadan, Meerut*
1901 June 5.	N.R.	Mann, Harold Hart, D.Sc., M.Sc., F.L.S., Principal, Agricultural College. *Poona.*
1899 Aug. 30.	L.M.	Mannu Lal, Rai Bahadur, Retired Civil Surgeon. *Rai Bareli.*
1919 Oct. 10.	N.R.	Manry, Rev. J. C *Ewing Christian College, Allahabad.*
1905 Dec. 6.	F.M.	Marsden, Edmund, B.A., F.R.G.S. 12. *Elerdale Road, Hampstead, London.*
1919 Oct. 29.	N.R.	Marten, John Thomas. *Hotel Cecil, Simla.*
1920 Aug. 4.	A.	Martin, Harold 6 & 7 *Clive Street Calcutta.*
1920 Aug. 4.	A.	Martin, Oswald 6 & 7, *Clive Street*, [*Calcutta*
1919 June 4.	N.R.	Matthai George. *Govt. College, Lahore.*
1920 Dec. 1.	R.	Mazumdar, B. C 33/1/C. *Lansdowne Road, Calcutta*
1886 Mar. 3.	L M.	Mehta, Roostumjee Dhunjibhoy, C.I.E 9, *Rainey Park Ballygunge, Calcutta.*
1884 Nov. 5.	N.R.	*Middlemiss, Charles Stewart, B.A., F G.S , F.A.S.B. *Kashmir, Srinagar.*
1884 Sept. 3.	A.	Miles, William Harry. *Europe* (*c o Messrs. J Mackillican & Co*).
1912 June 5.	N.R.	Misra. Champaram. *Partabgarh, Oudh.*
1916 Nov. 1.	R	Mitra, Adar Chandra, B.L. 164, *Bow Street, Calcutta.*
1919 June 4	R.	Mitra, Dr. Amulya Chandra, Medical Practitioner. *Burdwan.*
1919 Nov. 5.	N.R.	Misra, Pramatho Nath, Pleader. *Malda.*
1911 July 5.	N.R.	Misra, Rai Bahadur Pandit Shyam Behari, B.A., I.C.S., Deputy Collector. *Unao Oudh.*
1906 June 6.	R.	Mitra, Kumar Manmatha Nath. 34, *Shampukur Street, Calcutta.*

Date of Election.		
1919 April 2.	R.	Mitra, Panchanan. *Bangabasi College, Calcutta.*
1920 Dec. 1	N.R.	Mohammed Akbar Khan, The Hon'ble. Major, C.I.E., I.A. Chief of Hoti. *N.W.F.P.*
1916 Feb. 2.	R	Mohammad Yusuf, Hashimi, M.A. *The Madrasah, Calcutta.*
1921 June 1.	N.R.	Mohammad, Muzamilullah Khan, Khan Bahadur, O.B.E., Hon. Nawab, Taluqdar *Aligarh*
1895 July 3.	F.M.	Monahan, Francis John I.C.S. *Harrington Mansions, Calcutta.*
1906 Dec. 5.	N.R.	More, Major James Carmichael 51st Sikhs. *Kuwait, Persian Gulf*
1919 Feb 5.	R.	Moreno, H. W. B., B.A., Ph.D. 12, *Wellesley Street, Calcutta.*
1912 Jan. 10	R.	Muhammad Kazim Shirazi Aga. 23, *Lower Chitpur Road, Calcutta.*
1921 Feb 2	R.	Mukerjee, Ramaprasad, M.A., B.L. 77, *Russa Road, Bhowanipore.*
1921 Feb 2.	R.	Mukerjee, Subodh Chandra 97/2, *Musjid Bari Street, Calcutta.*
1909 Mar. 3.	R	Mukerjee, Brajalal, M.A., Solicitor. 12, *Old Post Office Street, Calcutta.*
1899 Sept 29	R.	Mukerjee, Jotindra Nath, B.A., Solicitor. 3, *Old Post Office Street, Calcutta.*
1916 Mar 1.	R.	Mukerjee Prabhat Kumar, Bar.-at-Law. 14A, *Ramtanoo Bose Lane, Calcutta.*
1898 May 4	R.	Mukerjee, Sir R. N., K.C.I.E. 7, *Harrington Street, Calcutta.*
1894 Aug. 30	R.	Mukerjee, Sibnarayan *Uttarpara, Bally*
1919 Feb. 5.	N.R.	Mukerjee, Taraknath. *Falka Colliery. Nirshachate P.O., Manbhum.*
1886 May 5.	L.M.	*Mukhopadhyaya, The Hon. Justice Sir Asutosh, Kt., C.S.I., M.A., D.L., D.Sc., F.R.S.E., F.R.A.S., F.A.S.B. 77, *Russa Road (North), Bhowanipur, Calcutta.*
1908 Feb 5.	R.	Mukhopadhyaya, Girindra Nath, B.A., M.D. 156, *Haris Mukerjee Road (North) Bhowanipur, Calcutta.*
1892 Dec. 7.	R.	Mukhopadhyaya, Panchanan. 46, *Bechoo Chatterji's Street Calcutta.*
1906 Mar. 7.	R.	Nahar Puran Chand, Solicitor. 48, *Indian Mirror Street, Calcutta.*
1920 Feb. 4.	N.R.	Narayan, Brij. *Roshanpura, Egerton Road, Delhi.*
1918 Sept 25.	N.R.	Narayan, Prince Victor N. *Cooch Bihar.*

Date of Election.		
1916 July 5.	R.	Naseer Hosein Khayal, Syed. 78, *Prinsep St., Calcutta.*
1914 Feb. 4.	R.	Nawab Ali Chaudhury, The Hon. Nawab Syed. 27, *Weston Street, Calcutta.*
1901 Mar. 6.	N.R.	Nevill, Lieut.-Col. Henry Rivers, I.C.S. *Cranagh, Simla.*
1917 Mar. 7.	A.	Newton, Rev. R. P., M.A. *Europe.*
1889 Aug. 29.	L.M.	Nimmo, John Duncan. *c/o Messrs. Walter Duncan & Co.,* 137 *West George Street, Glasgow.* [*Gorakhpur, U.P.*
1913 July 2	N.R.	Norton, E. L., I.C.S., District Magistrate.
1915 April 7.	A.	Otani. Count Kozui. (*c/o Consulate-General of Japan. Calcutta.*)
1907 July 3.	R.	Page, William Walter K., Solicitor. *Europe* (*c/o Messrs. Pugh & Co., Calcutta*).
1920 Aug. 4.	N.R.	Panikker, N. Padmanabha. Inspector of Fisheries. *Travancore.*
1920 Jan. 7.	N.R.	Parameshara Aiyar, S. *Travancore.*
1904 Aug. 3.	N.R.	Parasnis, Rao Bahadur, Dattalraya Balwant. *Satara.*
1919 Nov. 5.	R.	Pascoe, E. H., M.A., D.Sc., F.G.S. *Geological Survey of India, Calcutta.*
1910 April 6.	A.	Patuck, Pestonji Sorabji I.C.S. *Europe* (*c/o India Office*).
1906 Dec. 5.	R.	Peart, Major Charles Lubé, C.I.E., 106th Hazara Pioneers. *Europe* (*c/o Board of Examiners*).
1888 June 6.	L.M.	Pennell Aubray Percival, B.A., Bar.-at-Law. *Rangoon.*
1889 Nov. 6.	L.M.	*Phillott. Lieut.-Colonel Douglas Craven, Ph D., F.A.S.B., Indian Army (retired). *The Bury, Felsted, Essex, England.*
1914 Nov. 4.	A.	Pickford, Alfred Donald. 2. *Hare Street, Calcutta.*
1904 June 1.	R.	Pilgrim, Guy E., D.Sc., F.G.S. *Geological Survey of India, Calcutta.*
1910 Aug. 3.	R.	Podamraj Jain, Raniwalla. 9, *Joggomohan Mullick's Lane, Calcutta.*
1920 April 7.	N.R.	Pradhan, Hariprasad. *Pradhan Cottage, Darjeeling.* [*Calcutta.*
1918 April 3	R	Prashad, Baini, D.Sc., *Indian Museum,*
1914 Mar. 4.	A.	Raffin, Alain. *Europe.* [*pur.*
1880 April 7.	N.R.	Rai, Bepin Chandra. *Giridih, Chota Nag-*
1895 Aug. 29.	N.R.	Rai Chaudhuri, Jatindranath M.A., B.L., Zemindar. *Taki. Jessore.*

Date of Election.		
1920 Mar. 3	N.R.	Raj, B. Sundara. *Madras.*
1920 May. 7.	N.R.	Ram, Kamakhya Dat 21, *Clyde Road, Lucknow.*
1921 Dec. 2.	R.	Ranking, Colonel, Geo. S., C.M.G. *U.S. Club, Calcutta.*
1908 Feb. 5	A.	Randle, Herbert Neil. B.A. *Europe* (*c/o Queen's College, Benares*).
1917 June 6.	N.R.	Rangaswami Aiyangar, K. V., Rao Bahadur Prof. of History and Economics, H.H. The Maharaja's College. *Trivandrum*
1905 Jan. 4.	N.R.	Rankin, James Thomas I.C.S., Commissioner. *Dacca.*
1921 Jan. 5.	N R.	Ray, Maharaja Jagadisnath, Maharaja of Dinajpore. *Dinajpore.*
1890 Mar. 5	R.	*Ray, Sir Prafulla Chandra. Kt., D.Sc., F.A.S.B. *University College of Science, Calcutta*
1917 May 2.	R.	Ray, Kumud Sankar M.A., B.Sc., M.B., Ch.B (Edin.). 44, *European Asylum Lane, Calcutta.*
1920 Mar. 3.	N.R.	Raye, Narendra Nath. *Bhagalpur.*
1918 April 3.	F M.	Robinson, Herbert C. Director of Museums and Fisheries, Federated Malay States. *Kuala Lumpur*
1900 April 4.	A.	*Rogers, Lieut.-Col Sir Leonard, Kt., C.I.E., M D, B.S., F.R.C.P. F.R.C.S, F.A.S.B., F.R.S., I.M S. *Europe* (*c'o Medical College, Calcutta*).
1920 Mar. 3.	R.	Ronaldshay, The Right Hon. the Earl of, Governor of Bengal. *Calcutta.*
1901 Dec. 4.	F.M.	*Ross, Sir Edward Denison, Kt., C.I E., Ph.D., F.A.S.B., Director, School of Oriental Studies. *London.*
1918 July 3.	R	Roy, Dr. Bidhan Chandra, M.D, F R.C.S, M.R.C.P. (Lond.), Lecturer, Campbell Medical School. 36, *Wellington St., Calcutta.*
1921 Sept. 7.	R.	Roy, Hem Chandra 76/1*A*, *Upper Circular Road, Calcutta.*
1903 July 1.	L.M.	Roy, Maharaja Jagadindranath, Bahadur. 6, *Lansdowne Road, Calcutta.*
1915 Oct. 27.	R.	Roy, Kaviraj Jamini Bhusan, M.A., M.B., 46, *Beadon St, Calcutta.*
1920 July. 7.	R.	Roy-Chaudhuri, Hem Chandra. 43/2, *Amherst Street, Calcutta.*
1910 Sept. 7.	N.R.	Roy, Kumar Sarat Kumar, M.A *Dayarampur, Rajshahi.*

Date of Election.		
1919 Feb. 5.	R.	Roy, Srijut Sasadhar. 31, *Haris Mukerjee Street, Bhowanipore, Calcutta.*
1921 Feb. 2.	R.	Roy, Khagendra Bhusan. 6/3, *Ramdhan Mitter's Lane, Calcutta.*
1916 April 5.	N.R.	Saha, Radha Nath. 16, *Lachmikundu, Benares City.*
1913 Apl. 2.	N.R.	Sahay. Rai Sahib Bhagvati, M.A.. B.L , Offg. Inspector of Schools. *Bhagalpur*
1919 Sept 3.	N.R.	Saksena, Debi Prasad, Offg. Dy. Inspector of Schools. *Jhansi.*
1916 July 5.	R.	Sarkar, Ganpati. 69, *Baliaghata Main Road, Calcutta.*
1898 Mar. 2.	N.R.	Sarkar, Jadunath. *Ravenshaw College,* [*Cuttack.*
1909 Mar. 3.	R.	Sarvadhikari, Sir Deva Prasad, Kt., C.I.E , M A., B.L. 2 *Old Post Office Street. Calcutta.*
1917 Dec. 5.	R.	Sastri Ananta Krishna. 56 1a, *Sri Gopal Mullick Lane, Calcutta.*
1915 Feb. 3.	A.	Segard, Dr. C. P. *Europe.*
1919 April 2.	R	Sen, A. C. 80, *Lower Circular Road,* [*Calcutta*
1902 May 7.	R.	Sen, Jogendra Nath, Vidyaratna, M.A., 31, *Prasanna Kumar Tagore's Street Calcutta.*
1914 April 1.	N.R.	Sen-Gupta, Dr. Nares Chandra. *Dacca*
1897 Dec. 1.	R.	Seth. Mesrovb J. 19. *Lindsay Street, Calcutta.*
1911 July 5.	A.	*Sewell, Major Robert Beresford Seymour, M.R.C.S., L.R.C.P., I.M.S. *Europe* (c o *Indian Museum, Calcutta*).
1921 Nov. 2.	N R.	Shah. Emdadul Haq, M.L.C. *Vill. Bhowksar. P.S. Chandina, P.O. Dist. Mudafargar, Tippera.*
1909 Jan. 6.	N R.	Shirreff, Alexander Grierson, B.A., I.C.S. *Europe* (*c/o India Office*).
1913 Dec. 3.	R.	Shorten, Capt. James Alfred, B.A., M.B., B.Ch., I.M.S. *Medical College, Calcutta.*
1908 Mar. 4.	R.	Shujaat Ali, Nasirul Mamalik Mirza, Khan Bahadur, Acting Consul-General for Persia 10, *Hungerford Street, Calcutta.*
1916 Aug. 2.	N.R.	Shukla, Ashwani Kumar, B.A., LL.B., Revenue Officer, Mewar State. *Udaipur.*
1902 Feb. 5.	N.R.	Shyam Lal, Lala, M.A., LL B.. Deputy Collector. *Naimadri, Agra.*
1913 Mar. 5.	L.M.	*Simonsen, J. L., D.Sc.. F.A.S.B. *Forest Research Institute and College, Dehra-Dun.*

Date of Election.		
1909 April 7.	A.	*Simpson, George Clarke, D.Sc., F.A.S.B. *Europe.* (*c/o Meteorological Dept., Simla.*)
1918 Feb. 6	N.R	Singh, Badakaji Marichiman. 38, *Khichapokhari, Katmandu, Nepal.*
1894 July 4.	N.R	Singh, Raja Kushal Pal, M.A. *Narki.*
1912 May 1.	R.	Singh Roy, Rai Lalit Mohan, Bahadur. 15, *Lansdowne Road, Calcutta.*
1899 Aug. 29.	N.R.	Singh, H H. The Maharaja Sir Prabhu Narain, Bahadur, G.C.I.E., Maharaja of Benares. *Ramnagar Fort, Benares.*
1909 April 7.	N R.	Singh, Raja Prithwipal, Talukdar of Surajpur. *District Barabanki, Oudh.*
1899 Nov. 6.	L.M.	Singh, H.H. The Hon. Maharaja Sir Rameshwara, Bhahadur, K.C.I E. *Durbhanga.*
1913 July 2.	N.R.	Singh, Rudradat, M.A., LL.B., Vakil. *Lucknow.*
1894 Feb 7.	N.R.	Singh, H H. The Maharaja Vishwa Nath, Bahadur. *Chhatturpur, Bundelkhund.*
1919 Nov. 5.	N.R.	Singh, Shyan Narayan. Under Secretary to the Government of Bihar and Orissa. *Patna, E.I.R.*
1918 Feb. 6	R.	Singha, Kumar Arun Chandra, M.A. 120 3, *Upper Circular Road. Calcutta*
1918 April 3.	N.R.	Sinha. Raja Bahadur Bhupendra Narayan B A. *Nasipur Rajbati, Nasipur P O.*
1921 Feb 2.	N R.	Sinha, Gopinath, B.A., M.R.A.S. (London), Zemindar and Rais *Mohalla, Quanungu, Bareilly. U.P.*
1912 Sept. 5.	N.R.	Singhi, Bahadur Singh. *Azimgunj, Murshidabad.*
1913 July 2.	N.R.	Sivaprasad, B.A. Offg Junior Secretary to the Board of Revenue, U.P. *Allahabad.*
1920 June 2.	R	Skinner, S. A., Engineer and Director, Messrs. Jessop & Co., Ltd. 93, *Clive Street, Calcutta.*
1920 Mar. 3.	N.R.	Smith, P. Bosworth. *Oorgaum P.O.*
1901 Dec 4.	N.R.	*Spooner, David Brainard, B.A. Ph.D , F.A S.B. *Simla.*
1904 Sept. 28	A	Stapleton, Henry Ernest, B.A., B.Sc. *Ranna, Dacca.*
1908 Dec. 2.	R.	Steen, Major Hugh Barkley, M.B., I.M.S 1, *Upper Wood Street, Calcutta.*
1916 July 5.	R.	Street, W. S. *Messrs. Shaw Wallace & Co., Calcutta.*
1921 Mar. 2.	R.	Sturrock, Lieut.-Col. G. C., I.M.S. 14, *Park Mansions, Calcutta.*

Date of Election.		
1907 June 5.	R.	*Suhrawardy, Abdullah Al-Ma'mūn, Iftikharul Millat, M.A., D.Litt., LL.D., F.A.S.B., Bar.-at-Law. 56, *Mirzapur Street, Calcutta.*
1920 Jan. 7.	R	Suhrawardy, Hassan, M.D., F.R.C.S.I., L.M. (Rotunda), F.M.S., London, F.C.U., District Medical Officer. *Lillooah, E.I.R.*
1916 Sept. 27.	A.	Sutherland, Rev. W. S., D.D., Scottish Universities Mission. *Kalimpong, Darjeeling Dist.*
1919 June 4.	A.	Tacchella, C. F. H. *Europe (c/o Indian Institute of Science, Bangalore).*
1909 Jan. 6.	R.	Tagore, Kshitindranath, B.A. 6/1, *Dwarkanath Tagore Lane, Calcutta.*
1914 April 1.	R.	Tagore, Prafulla Nath. 1, *Darpanarain Tagore Street, Calcutta.*
1898 April 6	R.	Tagore, The Hon. Maharaja Sir Prodyat Coomar, Bahadur, Kt. *Pathuriaghatta, Calcutta*
1904 July 6.	F.M.	Talbot, Walter Stanley, I.C.S. c/o Messrs. H. S. King & Co. 9, *Pall Mall, London, S.W.*
1910 Aug. 3.	N.R.	Tancock, Major Alexander Charles. 31*st Punjabis, Nowshera, N.W.F.P.*
1893 Aug. 31.	N.R.	Tate, George Passman. 56, *Cantonment, Bareilly, U.P.*
1906 Dec. 5.	N.R.	Tek Chand, Dewan, B.A., M.R.A.S., I.C.S., Deputy Commissioner. *Gujranwala, Punjab.*
1878 June 5.	F.M.	Temple, Colonel Sir Richard Carnac, Bart., C.I.E., Indian Army. 9 *Pall Mall, Lond.*
1909 Aug. 4.	N.R.	Thompson, John Perronet, M.A., I.C.S. Chief Secretary, Govt. of the Panjab. *Lahore.*
1904 June 1.	R.	*Tipper, George Howlett, M.A., F.G.S., F.A.S.B. *(c/o Geological Survey of India, Calcutta.)*
1921 Dec. 7.	N.R.	Telang, P. A., Prof. of History. *Benares Hindu University, Benares City.*
1861 June 5.	L.M.	Tremlett, James Dyer, M.A., I.C.S. (retired). *Dedham, Essex, England.*
1917 Dec. 5.	N.R.	Tripathi, Ramprasad, Reader in Modern Indian History. *The University, Allahabad.*
1894 Sep. 27.	R.	Vasu, Nagendra Nath. 20, *Visvakosh Lane, Bagbazar, Calcutta.*

Date of Election.		
1901 Mar. 6.	F.M.	*Vogel, Jean Philippe, Litt.D., F.A.S.B. *The University, Leiden, Holland.*
1894 Sept. 27.	L M.	Vost, Lieut.-Col. William, I.M.S., 26, *Crystal Palace Rack Road, Sydenham, London, S.E*
1902 Oct. 29.	R.	*Vredenburg, Ernest, B.L., B.Sc., A.R.S.M., A.R.C.S , F.G.S., F.A.S.B., Europe (c/o *Geological Survey of India, Calcutta*).
1907 July 3.	R	Walker, Harold, A.R.C.S., F.G.S., A.M. Inst.M , Assistant Superintendent, Geological Survey of India. *Calcutta.*
1918 April 3.	N.R.	Wall, Col. F., C.M.G , C.M.Z.S., F.L.S. I M S. *Sind Club, Karachi.*
1911 Feb. 1.	N.R.	Waters, Harry George, F.R.I.P.H., Chief Medical Officer, E I R. *Allahabad.*
1909 Dec. 1.	N.R	Webster. J. E., I.C.S. *Sylhet, Assam.*
1913 April 2.	A	White, Bernard Alfred. *Chartered Bank Buildings, Calcutta.*
1915 Jany. 6.	N.R.	Whitehouse. Richard H. (I.E.S). *Central Training College, Lahore.*
1906 Sept. 19.	N R.	Whitehead, Richard Bertram, I.C.S. *Rupar, Umbala, Punjab.*
1915 May 5.	N.R.	Williams, L. F. Rushbrook, B.A., B.Litt *Europe (c/o Allahabad University).*
1919 May 7.	N.R.	Wills, Cecil Upton, B.A., I.C.S. *Nagpur.*
1906 Mar. 7.	N.R.	Woolner, Alfred Cooper, M.A. *Punjab University, Lahore.*
1908 April 1.	R.	Wordsworth. William Christopher. *Presidency College, Calcutta.*
1894 Aug. 30.	N.R.	Wright, Henry Nelson, B.A., I.C.S Dist. Judge. *Bareilly.*
1911 Aug. 2.	A.	Young, Gerald Mackworth, B.A., I.C S. *Europe (c/o India Office).*
1906 June 6.	F.M.	Young, Mansel Charles Gambier. *Khagaul P.O. Dinapore, E.I.R.*
1910 April 6.	N.R.	Young. Capt. Thomas Charles McCombie, M.B., I.M.S. *Shillong, Assam.*
1919 Feb. 5.	N.R.	Yazdani, G. *Hyderabad, Deccan.*
1919 July 2.	N.R.	Zafar Hasan, *Archæological Survey of India, Delhi.*

SPECIAL HONORARY CENTENARY MEMBERS.

Date of Election.	
1884 Jan. 15.	Revd. Professor A. H. Sayce, Professor of Assyriology, Queen's College. *Oxford, England.*
1884 Jan. 15.	Monsieur Émile Senart. 18, *Rue François Ier, Paris, France.*

HONORARY FELLOWS.

Date of Election.	
1879 June 4.	Dr. Jules Janssen. *Observatoire d'Astronomie Physique de Paris, France.*
1895 June 5.	Charles H Tawney, Esq., M.A., C.I.E. *c/o India Office, London.*
1896 Feb. 5.	Professor Charles Rockwell Lanman. 9, *Farrar Street, Cambridge, Massachusetts, U.S. America.*
1899 Dec. 6.	Professor Edwin Ray Lankester, M.A., LL.D., F.R.S. *British Museum (Nat. Hist.), Cromwell Road, London, S.W.*
1904 Mar. 2.	Professor Sir Ramkrishna Gopal Bhandarkar, K.C.I.E. *Poona.*
1904 Mar. 2.	Sir George Abraham Grierson, K.C.I.E., Ph.D., D.Litt., C.I.E., I.C.S. (retired). *Rothfarnham, Camberley, Surrey, England.*
1906 Mar. 7.	The Right Hon'ble Baron Curzon of Kedleston, M.A., D.C.L., F.R.S. 1, *Carlton House Terrace, London, S.W.*
1908 July 1	Lieut.-Col Henry Haversham Godwin-Austen, F.R.S., F.Z.S., F.R.G.S., *Nora Godalming, Surrey, England.*
1911 Sept. 6	Lieut.-Col. Alfred William Alcock, C.I.E., M.B., LL.D., C.M.Z.S., F.R.S., I.M.S. (retd.). *Heathlands. Erith Road, Belvedere, Kent, England.*
1911 Sept. 6.	Prof. Edward George Browne, M.A., M.B., M.R.C.S., L.R.C.P., M.R.A.S. *Pembroke College, Cambridge.*
1911 Sept. 6.	Mahamahopadhyaya Kamakhyanath Tarkavagisa. 111/4, *Shambazar Street, Calcutta.*
1915 Aug. 4.	Prof. Sir Paul Vinogradoff, F.B.A., D.C.L. 19, *Linton Road, Oxford, England.*
1915 Aug. 4.	Sir Patrick Manson, G.C.M.G., M.D., LL.D., F.R.C.P. 21, *Queen Anne Street, Cavendish Square, London, W.*

Date of Election.	
1915 Aug. 4.	Sir Joseph John Thomson, Kt., O.M., M.A., Sc.D., D.Sc., LL.D., Ph.D. *Trinity College, Cambridge, England.*
1916 Dec. 6.	Dr. G. A. Boulenger, F.R.S., LL.D., British Museum (Nat. Hist.). *Cromwell Road, London, S.W.*
1917 May 2.	Herbert A. Giles, Esq., LL.D., University of Cambridge. *Cambridge.*
1920 Feb. 4.	Sir Charles Eliot, K.C.M.G., C.B., M.A., LL.D., D.C.L. *H.M. Ambassador at Tokyo.*
1920 Feb. 4.	Prof. T. W. Rhys Davids, LL.D., Ph.D., D.Sc. *University College, London.*
1920 Feb. 4.	Prof. Sylvain Lévi, Collège de France. *Paris.*
1920 Feb. 4.	Sir Aurel Stein, K.C.I.E., Ph.D., D.Litt., D.Sc. *Srinagar, Kashmir.*
1920 Feb. 4.	Prof. A. Foucher, D.Litt., University of Paris.
1920 Feb. 4.	Arthur Keith, Esq., M.D., F.R.C.S., LL.D., F.R.S. Royal College of Surgeons of England. *Lincoln's Inn Fields, London, W.C. 2.*
1920 Feb. 4.	R. D. Oldham, Esq., F.R.S., F.G.S., F.R.G.S. *1, Broomfield Road, Kew, Surrey, England.*
1920 Feb. 4.	Sir David Prain, Kt., C.M.G., C.I.E., M.A., M.B., LL.D., F.R.S.E., F.L.S., F.R.S., F.Z.S., M.R.I.A., *Royal Botanic Gardens, Kew, Surrey, England.*
1920 Feb. 4.	Sir Joseph Larmor, Kt., M.P., M.A., D.Sc., LL.D., D.C.L., F.R.S., F.R.A.S. *Cambridge.*
1920 Feb. 4.	Sir James Frazer, Kt., D.C.L., LL.D., Litt.D. *1, Brick Court, Temple, London, E.C. 4.*
1920 Feb. 4.	Prof. J. Takakusu. *Imperial University of Tokyo, Japan.*

FELLOWS.

Date of Election.	
1910 Feb. 2.	N. Annandale, Esq., D.Sc., C.M.Z.S., F.L.S.
1910 Feb. 2.	The Hon'ble Justice Sir Asutosh Mukhopadhyaya, Kt., C.S.I., M.A., D.L., D.Sc., F.R.A.S., F.R.S.E.
1910 Feb. 2.	I. H. Burkill, Esq., M.A., F.L.S.
1910 Feb. 2.	Mahamahopadhyaya Haraprasad Shastri, C.I.E., M.A.
1910 Feb. 2.	Sir Thomas Holland, K.C.S.I., K.C.I.E., D.Sc., A.R.C.S., F.G.S., F.R.S.

Date of Election.	
1910 Feb. 2.	T. H. D. La Touche, Esq., B.A., F.G.S.
1910 Feb. 2.	Lieut.-Colonel D. C. Phillott, Ph.D., Indian Army (retired)
1910 Feb. 2.	Sir Prafulla Chandra Ray, Kt. D.Sc.
1910 Feb. 2.	Lieut.-Col. Sir Leonard Rogers, Kt., C.I.E., M.D., B.S., F.R.C.P., F.R.C.S., F.R.S., I.M.S.
1910 Feb. 2.	Sir E. D. Ross, Kt., C.I.E., Ph.D.
1910 Feb. 2.	M. W. Travers, Esq., D.Sc., F.R.S.
1911 Feb. 1.	Sir H. H. Hayden, Kt., C.S.I., C.I.E., D.Sc., B.A., B.E., B.A.I., F.G.S., F.R.S.
1912 Feb. 7.	H. Beveridge, Esq., I.C.S. (retired).
1912 Feb. 7.	Sir J. C. Bose, Kt., C.S.I., C.I.E., M.A., D.Sc.
1912 Feb. 7.	P. J. Bruhl, Esq., Ph.D., F.C.S.
1912 Feb. 7	Capt. S. R. Christophers, I.M.S.
1912 Feb. 7.	Charles Stewart Middlemiss, Esq., B.A., F.G.S.
1912 Feb. 5.	Lieut.-Col. A. T. Gage, I.M.S.
1913 Feb. 5.	E. Vredenburg, Esq., B.L., B.Sc., A.R.S.M., A.R.C.S., F.G.S.
1913 Feb. 5	J. Ph. Vogel, Esq., Ph.D., Litt.D.
1913 Feb. 5.	Dr. S. W. Kemp, B.A.
1915 Feb. 3.	Major E. D. W. Greig, C.I.E., M.B., I.M.S.
1915 Feb 3.	G. H. Tipper, Esq., M.A., F.G.S.
1915 Feb 3.	D. B. Spooner, Esq., Ph.D.
1915 Feb. 3.	H. H. Haines, Esq., F.C.H., F.L.S.
1916 Feb. 2.	Lieut.-Col. C. Donovan, M.D., I.M.S.
1916 Feb. 2.	R. Burn, Esq., C.I.E., I.C.S.
1916 Feb. 2.	L. L. Fermor, Esq., A.R.S.M., D.Sc., F.G.S.
1917 Feb. 7.	G. C. Simpson, Esq., D.Sc., F.R.S.
1917 Feb 7.	F. H. Gravely, Esq., D.Sc.
1918 Feb. 6.	J. L. Simonsen, Esq., Ph.D.
1918 Feb. 6.	Lieut.-Col. D. McCay, M.D., I.M.S.
1918 Feb. 6.	Abullah Al-Mámun Suhrawardy, Esq., M.A., Ph.D.
1919 Feb. 5.	J. Coggin Brown, Esq., O.B.E., M.I.M.E., F.G.S.
1919 Feb. 5	W. A. K. Christie, Esq., B.Sc., Ph.D.
1919 Feb. 5.	D. R. Bhandarkar, Esq., M.A.
1919 Feb. 5.	Major R. B. Seymour Sewell, I.M.S.
1921 Feb. 2.	Lieut.-Col. F. Wall, C.M.G., I.M.S.
1921 Feb. 2.	U. N. Brahmachari, Esq., M.A., Ph.D., M.D.
1921 Feb 2.	B. L. Chaudhuri, Esq., B.A., D.Sc., F.L.S., F.R.S.E.

ASSOCIATE MEMBERS

Date of Election.	
1875 Dec. 1.	Revd. J. D. Bate. 15, *St. John's Church Road, Folkestone, Kent, England.*
1885 Dec. 2.	Dr. A. Führer, Prof. of Sanskrit, 5, *Dorenbachstrasse, Binningen, Basel, Switzerland.*

Date of Election.	
1899 Nov. 1.	Revd. E. Francotte, S.J. 30, *Park Street, Calcutta.*
1902 June 4.	Revd. A. H. Francke *Europe.*
1908 July 1.	Rai Sahib Dinesh Chandra Sen, B.A. 19, *Visvakos Lane, Calcutta.*
1910 Sept 7	Shamsul Ulama Maulavi Ahmad Abdul Aziz *Azeez Bag, City-Hyderabad, Deccan.*
1910 Sept. 7.	L. K. Anantha Krishna Iyer, Esq. *Trichur.*
1910 Dec. 7.	Rev. H. Hosten, S.J. 30. *Park Street, Calcutta.*
1915 Mar 3.	E. Brunetti, Esq. 27, *Chowringhee Road, Calcutta.*
1915 Dec. 1	Pandit Jainacharya Vijayadharma Surisvaraji, *Yasovijaya Granthamal Office, Benares City.*
1919 Sept. 3.	H. Bruce Hannah Esq., *Bengal Club, Calcutta*
1921 Jan. 5.	Professor Shahay Ram Bose, M.D., F.L.S.

LIST OF MEMBERS WHO HAVE BEEN ABSENT FROM INDIA THREE YEARS AND UPWARDS.*

* *Rule* 40.—After the lapse of three years from the date of a member leaving India, if no intimation of his wishes shall in the interval have been received by the Society his name shall be removed from the List of Members.

The following members will be removed from the next Member List of the Society under the operation of the above rule :—

Lieut.-Col. C. Donovan, M.D., I.M.S., F.A.S.B.
Geoffrey D. Hope, Esq., B.Sc., Ph.D.
Rev. R. P. Newton M.A.
Pestonji Sorabji Patuck, Esq., I.C.S.
Dr. C. P. Segard.
Herbert Neil Randle, Esq., B.A.

LOSS OF MEMBERS DURING 1921.

BY RETIREMENT.

Ordinary Members.

Mr. C. A. Silberrad, I.C.S.
Rev. Anagarika Dharmapala.
Mr. G. R. Kaye, F.R.A.S.
The Hon. Justice T. W. Richardson, I.C.S.

Lieut.-Col. E. H. Brown, M.D., I.M.S. (retired).
The Hon. Mr. W. W. Hornell.
The Ven'ble W. K. Firminger, M.A., B.D., F.R.G.S.
Mr. W. E. Andrews, B.A. (Oxon).
Sir J. G. Cumming, K.C.I.E., C.S.I., C.I.E., I.C.S., (retired).
Dr. Gopal Chandra Chatterji, M.B.
Sir Edward Gait, K.C.S.I., C.S.I., C.I.E., F.A.S.B., I.C.S.
Dr. G. D. Hope, B.Sc., Ph.D.
Lt.-Col. F. O'Kinealy M.R.C.S. (Eng.), L.R.C.P. (Lond.), I.M.S.
Lala Sita Ram, B.A.

By Death.

Ordinary Members.

Babu Roormall Goenka.
Babu Pratapa Chandra Ghosh, B.A
Shaikh Laiq Ahmed Ansari
Dr. Suresh Prasad Sarvadhikari.
Mr Jogendra Nath Das Gupta, B.A (L.M.).
Lieut.-Col C. T. Peters, M.B., I.M.S. (retired).

Hon. Fellow.

Prof. E. B. Tylor, D.C.L., LL.D. F.R.S

Rule 38.

Abul Kalam Mohyuddin Ahmed Azad.
Babu Rama Nath Khanna.
Prof. Kazunobu Kanokagi.
Pandit Harnarayan Shastri.
Babu Daya Ram Sahni
Babu Kashi Nath Das.

Rule 40

Capt F. T. P. Ebden, 73rd Carnatic Infantry.
Dr. A. M. Meerwarth
Rev. R. Oka
Alain Raffin, Esq
Morris William Travers, Esq.

ELLIOTT GOLD MEDAL AND CASH.

Recipients.

1893	Chandra Kanta Basu.
1895	Yati Bhusana Bhaduri, M.A.
1896	Jnan Saran Chakravarti, M.A.
1897	Sarasi Lal Sarkar, M.A.
1901	Sarasi Lal Sarkar, M.A.

1904	Sarasi Lal Sarkar, M.A.
	Surendra Nath Maitra, M.A.
1907	Akshoyakumar Mazumdar.
1911	Jitendra Nath Rakshit.
	Jatindra Mohan Datta.
1913	Rasik Lal Datta.
	Saradakanta Ganguly.
	Nagendra Chandra Nag.
	Nilratan Dhar.
1918	Bibhutibhushan Dutta, M.Sc.
1919	Dr. Jnanendra Chandra Ghosh.

BARCLAY MEMORIAL MEDAL.

RECIPIENTS.

1901	E. Ernest Green, Esq.
1903	Major Ronald Ross F.R.C.S., C.B., C.I.E., F.R.S., I.M.S. (retired).
1905	Lieut.-Colonel D. D. Cunningham, F.R.S., C.I.E., I.M.S. (retired).
1907	Lieut.-Colonel Alfred William Alcock, M.B., LL.D., C.I.E., F.R.S.
1909	Lieut.-Colonel David Prain, M.A. M.B., LL.D., F.R.S., I.M.S. (retired).
1911	Dr. Karl Diener.
1913	Major William Glen Liston, M.D., C.I.E., I.M.S.
1915	J. S. Gamble, Esq., C.I.E., M.A., F.R.S.
1917	Lieut.-Colonel Henry Haversham Godwin-Austen, F.R.S., F.Z.S., F.R.G.S.
1919	N. Annandale, Esq., D.Sc., C.M.Z.S., F.L.S., F.A.S.B.
1921	Lieut.-Col. Sir Leonard Rogers, F.R.S., C.I.E., F.R.C.S., M.D., B.Sc., F.R.C.P., I.M.S. (retired).

NOTE ON

PROCEEDINGS OF THE ORDINARY GENERAL MEETINGS, 1921.

These have been published in Volume XVII, 1921, No. 4, pp. ccxlix–cclxv No meetings were held in October and November.

Proceedings
# of the
Ninth
Indian Science Congress.

[*Journal and Proceedings of the Asiatic Society of Bengal.*]

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PROCEEDINGS OF THE NINTH INDIAN SCIENCE CONGRESS.

The Ninth Annual Meeting of the Indian Science Congress was held in Madras from January 30th to February 4th After the Patron, His Excellency Lord Willingdon, G.C S.I , G.C.I.E., G.B.E., Governor of Madras, had welcomed the visitors in a short speech, the President, C. S. Middlemiss, Esq., C.I.E., B.A., F A.S.B., F R.S , delivered his address.

Presidential Address.

I am afraid my appearance in the role ot President must be rather disappointing to many of you: you would have been much more gratified had Sir Thomas Holland been able to keep his appointment by presiding over our counsels in this place, as was originally arranged. Unfortunately Sir Thomas has left the country, and India and the Science Congress, I need hardly say, are the poorer thereby. I am sure my audience will unite with me in deploring the turn of events that has robbed us of his guiding presence to-day.

When in a moment of weakness I accepted the invitation of your Committee (only as recently as September last) to act in Sir Thomas' place, I was in far-off Ladakh and had to telegraph my decision promptly. Since then there have been occasions when I repented of my hasty action. not because I failed to appreciate the great honour that has thus unexpectedly fallen to my lot, not because there are no attractive features associated with the post of President and with the stimulating task of preparing an address, nor yet because I was unwilling to help in any way I could the cause of science in India—my regret has been chiefly on your account, because I realized how inadequate my best efforts must be compared with what you were naturally looking forward to from a man of such great personality and wide experience as Sir Thomas Holland

However. in spite of misgivings, I find myself here to-day and must endeavour to discharge the duties of this office to the best of my ability. Coming to the subject matter of this address—I have naturally made no attempt to condense an account of the far-flung line of advance achieved by science during the past year: this is a task that everyone now admits as being far too formidable, even if the requisite ability to do so were not wanting. Nor have I attempted any 'potting' process in my own special line of mineral and geological survey work: this is not the time nor the place for such technical disquisitions, which are apt to be barren and unconvincing unless accompanied by a full array of practical demonstrations.

Restricted, also, as I have been by the short time and shorter leisure at my disposal and by my remote surroundings, mainly in camp, away from reference facilities, I have been compelled to limit the scope of this address to quite modest dimensions. I propose to record a few musings (I cannot call them more) that I have indulged in on some borderland aspects of science and quasi-science, which are prominently in the public eye just now, and to describe one or two mineral and survey problems that have come recently within my own purview. The former seem to me to claim your attention and demand some sort of expression at this time, no matter how imperfectly I may do it—as to which I ask your indulgence for reasons already given.

RELATIVITY.

My first essay in this line is a few comments on Relativity. In making these I have been moved by two considerations—the impossibility of ignoring so momentous a subject altogether and the difficulty in handling it suitably. Previous references to Relativity, which have been made in the Physics and Mathematics Section at earlier sessions of this Congress and which have grown in volume each year, show that this new concept has already attracted much attention from some of those members best qualified to judge and appreciate it—such as Drs. Walker, Mallik and Moos—and it has been accepted tentatively by them and by other physicists as a means of escape from the bewildering difficulties that are nowadays presented by the dynamical principles governing physical phenomena, though others again are less enthusiastic, or even opposed to it.

The name of Einstein is inseparably connected with this revolutionary or Bolshevist (as some stigmatise it) view of the universe, which has caused a sensation unequalled perhaps since the days when evolution and Darwinism (in a different region of scientific thought) came to startle and shock the world.

The novel idea of Relativity grew with ever-increasing rapidity and was discussed at meetings of scientific societies, including as already remarked our earlier Congresses. But it is only quite recently that the theory began to catch the popular imagination—I suppose by reason of its very novelty and strangeness. It thus broke away from the charmed circle of the mathematicians and physicists and has become quite an obsession with most thoughtful people. This was facilitated by the wide advertisement the theory received by means of the very large number of explanatory papers, pamphlets, magazine and newspaper articles and books devoted to the subject that have flooded the world during the last two years. At the present moment it seems as though the curious world is watching expectantly to see whether this oracular concept is destined to mark a crisis in the history of physical science. and radically alter and transform knowledge to a higher level. or whether it will not itself require transformation first.

Now I make no claim to any inner knowledge of Relativity, which is normally outside my more mundane sphere of work, and I regret that I am not familiar with the mathematical apparatus of theoretical physics, from out the intricacies of which the concept emerged. But, in answer to this universal appeal for a decision, I am approaching the subject from the standpoint of the ordinary scientific worker, or of what has become typified in the expression—the 'plain man —who is inclined to view with some alarm the necessity for realizing in thought such things as a space-time continum. having an extra co-ordinate with a time factor, in addition to the usual three.

The plain man's opinion is thus invited; and my word to-day to this Congress is that I am dissatisfied with these attempted explanations of Relativity. Not all the prize competition essays in the *Scientific American*, nor the didactic articles and booklets that have appeared in such profusion. seem really to bring the matter down to the terms of common understanding—a goal that is eminently desirable if the theory is to live and fructify in the general mind of the world.

Among these explanations, Einstein's own book, "Relativity: The Special and the General Theory," [1] notwithstanding the statement in the preface that it is intended as far as possible to give an exact insight into the theory to general readers, is not the least unsatisfactory as it seems to me. This may be accounted for by the author's transcendent mind, which cannot appreciate the plain man's difficulties—but I am not sure of this. The explanations and illustrative cases in that work have the effect on the ordinary intelligence as of dealing in contradictions and outraging common-sense—by which I mean that educated common-sense which has grown up with experimental science and become a second intuitive instinct. In common with others I have been fascinated and confounded in turn by the theory, fascinated by the way Einstein and others parade in full daylight and sanction ideas that had previously been regarded as pseudo-scientific speculation, which men of deep learning now and then toyed with in thought perhaps, but never seriously entertained; and I have been confounded by what seem to be the inadequate if not exactly inappropriate illustrations of the theory given by Einstein himself.

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[1] Authorised translation by Robert Lawson (Methuen), 192

The Principle of Relativity, and the Special and General theories as elaborated by Einstein, must be familiar to most of my audience. I do not propose to attempt any further explanation of these explanations, nor any criticisms of them as wholes. But here and there in those explanations we meet with definite concrete statements of supposed facts, which if closely examined or followed out seem unacceptable to an ordinary intelligence. I feel that these should be stated, as I cannot believe that I alone am unfortunate in having encountered these stumbling-blocks in the way of accepting the theories as credible.

I shall proceed at once to focus on one or two points only, to exemplify the above. Let me refer first to Einstein's illustration of what he speaks of as the 'relativity of simultaneity': Lightning has struck the railway line at two distant points, and, in answer to Einstein's demand for a method of proving or disproving the simultaneity of the two flashes,' he supposes a reply that involves placing two mirrors at the middle point, so arranged that the two flashes could be seen together. Then, simultaneity he more or less grudgingly agrees would be established if the two flashes were seen at one and the same moment in the twin mirrors. But this only for a person at rest at the middle point. As regards a person moving in a railway carriage and passing the centre point at the moment of the flashes, he contends that the flashes as seen in the mirrors would appear consecutive and not simultaneous. Hence, he states, simultaneity of two events is different for two observers, one stationary and one in movement—that in fact simultaneity is a relative matter. This fictitious experiment (as little to the point, as it seems to me, as it the flash and report of a gun had been taken in illustration) colours all the arguments for the Special theory of Relativity; and hence we get figuring in the equations the ever-appearing ratio $\frac{v^2}{c^2}$ where v is the velocity of the body and c that of light.

Now, in spite of my wish not to be dogmatic, I think it may well be a question for any person here, or indeed for any matriculation student or intelligent schoolboy, to ask whether Einstein has not woefully (if not wilfully) confused an event with the transmission of the effects of that event to a distant point by the medium of light. The lack of simultaneity of the two flashes perceived in the two mirrors by the person in the moving train seems to have nothing to do with the two events themselves, which were either simultaneous or they were not so. I think that without further words one may decide that to get or prove simultaneity in any such happenings as two explosive flashes is simply a matter of observation. By suitable apparatus one might go on refining the limits of possible error, reducing them we will say to from 1/10 second to 1/100 or even 1 1000 of a second, and so we could say the simultaneity was precise to within that limit of error. But this is a very different concept to what one must understand by the expression relativity of simultaneity. It would seem as though Einstein, in despair of attaining mathematically exact simultaneity, had cut the knot of the trouble by framing an artificial simultaneity, making it dependent on the speed of light.

The next point I will refer to is a statement repeatedly met with in Einstein's exposition of his theories, to the effect that, in any system in movement with regard to another, a clock will lose time or go permanently slower from the point of view of the observer outside that moving system. The ratio $\frac{v^2}{c^2}$ still comes into the argument, for the unit second has to be represented by the expression

$$\frac{1}{\sqrt{1-\frac{v^2}{c^2}}},$$

a somewhat longer period. The difference is no doubt a very small fraction indeed to consider; but the peculiarity in such an equation is that the speed of light should have anything to say in the matter at all, since moving objects and ticking clocks may operate for ever in darkness just as well as in the glare of daylight. Furthermore, it seems to me that a car at Brooklands carrying a good chronometer, or the rim of a flywheel with a watch packed away inside it, ought in that case to record any such cumulative difference, if the experiment be continued long enough with resting intervals. In fact, on any set of continuously observed journeys, our clocks and watches in the same way would necessarily appear to lose time and require resetting to accord with stationary time, and time-pieces in equatorial regions of the earth, as compared with polar clocks, must lose frightfully—all of which seems to be nonsense, since as we know, or can easily know, this does not happen in fact.

But it is what Einstein nevertheless says does happen, as the following references will show. At page 37 he writes :—

> "as a consequence of its motion the clock goes more slowly than when at rest,"

(not, be it understood, lags behind, but loses time continuously and therefore cumulatively).

Again, with reference to a rotating disc, at page 81 :—

> "as judged from this body [the stationary system *K*], the clock at the centre of the disc has no velocity, whereas the clock at the edge of the disc is in motion relative to *K* in conse-

> quence of the rotation. According to a result obtained in Section XII, it follows that the latter clock goes at a rate permanently slower than that of the clock at the centre of the circular disc, that is as observed from *K*. It is obvious that the same effect would be noted by an observer whom we will imagine sitting alongside his clock at the centre of the circular disc."

But it is not at all obligatory to descend to actual base experiment in order to show a very extraordinary and contradictory result in the above proposition regarding clocks. I must remind you that Einstein postulates that not only will the clock in movement lose time continuously from the point of view of the stationary observer, but also his clock will lose time continuosly as viewed from the moving car (to revert to the Brookland's experiment). That is the most amazing part of the business— each observer sees the other's clock slow (for it is a matter of course to Einstein that this must happen by the simple Principle of Relativity). Now, let us assume some unheard of speed for the car and some sufficiently long continued period (which we are entitled to do since the experiment is purely imaginary), then a moment will surely come when the observer in the rushing car and the observer on the ground each sees the other's clock registering, let us say, five minutes slow compared to his own. This seems all logical and correct according to the premises, for it is hardly necessary to remark that a clock that appears to lose a definite amount each second with regard to another is constantly getting more and more 'behind time' with regard to that other. At this juncture, when the five minutes difference manifests itself, let the car stop. The two observers, keeping their eyes fixed on their respective clocks all the time, meet on terra firma and compare their clocks together. These, then, according to Einstein's contention, must present the egregious spectacle of being five minutes *behind each other* (a contradiction in terms, you will notice), and we have arrived as I anticipated at the quaintest possible *reductio ad absurdum!*

Those of you who do not know your Einstein may think that I am romancing, but nothing is further from my thought or intention. It is an entirely true picture of what follows from the case as presented by Einstein, unless, indeed, we make the grotesque assumption that at the moment of the stoppage of the car each clock leaps forward five minutes to satisfy the point of view of the other observer (a proceeding that no well regulated clock could be suspected of except in a nightmare)—and all is well again! I am not alone in my distrust of this travesty of an experiment. Sir Oliver Lodge discusses the same case, but somewhat differently in *Nature*.[1] He writes:—

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[1] Relativity Number, 17th Feb., 1921, footnote, page 797.

> "It is not easy to explain without symbols why earth-bound clocks should appear to go slow to an aviator and an aviator's clock appear to go slow to the man on the ground. The plain man would think that they would both appear to go fast during approach and slow during recession; but the meaning is not so simple as that. Nor is it because a pendulum has lengthened or anything physical or real of that sort The argument appears to be that the other man's clock must be estimated as relatively slow by each of the two observers moving relatively to each other, because otherwise they could measure different velocities of light; which though not repugnant to common-sense is contrary to the basic Principle of Relativity."

You will notice in this quotation that Oliver Lodge is compelled to conclude that Einstein does not mean what he says about clocks under these conditions of relative movement, but intends it as an inference, a conclusion or result of the mystery of the supposed uniform velocity of light when measured under any conditions. But it seems equally clear that, even as an inference, the statement as made, or the premises on which it is based, must be defective, else the statement could not be reduced to an absurdity as shown in my illustration of the car at Brooklands.

Certain critics or apologists have ventured to say that no physical difference between the clocks is contemplated by Einstein in his statement. Thus "Aurelius" (Dr. Francis D. Murnaghan of Baltimore) in the *Scientific American* of Feb. 1921, writes, page 198, footnote :—

> "Thus when it is said that a body contracts or that a clock runs slow when it is put in motion, no actual physical change is implied. The judgment of different observers—one at rest with respect to the body and one not—are different"

This I cannot grant. Einstein at the beginning of Section XIII, page 38, of his book expressly remarks as follows :—

> "Now in practice we can move clocks and measuring rods only with velocities that are small compared with the velocity of light; hence we shall hardly be able to compare the results of the previous section with the reality."

A statement that clearly contemplates that experiment *would* show a physical difference if we were able to move these objects sufficiently rapidly. If he does not mean this the sentence has no object.

Oliver Lodge, further on in the Relativity number of *Nature*, near the end of what one cannot but regard as a brilliant piece of satire on the whole Relativity question, relieves himself as follows :—

> " . . . too much attention may be paid to the mere reception of information; and what is spoken of as a "warping" is not limited to space alone. For some philosophers speak as if the duration of an event could be extended by merely delaying the reception of the news of its end as if one could prolong a man's life by evading the tidings of his death, and might be entitled to say without absurdity, that a man who died at

> seventy had lived seventy-one years and a lot of miles, if we had travelled so far that the messenger took a year to reach us. That such things can be gravely uttered is surely a tribute to the beauty and complexity of the mathematical scheme which can temporarily warp the judgment even of the most competent."

I have confined my remarks to the above instances because they constantly enter into the illustrations given in explanation of the Theory of Relativity. Clocks whether on rushing trains or whirling discs are always assumed as losing time in hypothetical experiments by Einstein and those following him.

Now I must not be understood for a moment as presuming to condemn Einstein's theory or theories in their original mathematical form as attempts to geometrise physics. I must leave that to others. I simply echo the protest against his endeavour to give quasi physical interpretation to the formal equations in terms which involve time as a variable. It leads to imaginary experiments that are practically impossible or very difficult of realization or can be shown to be self-contradictory, and it violates our fundamental concepts of time and space These latter, I venture to contend, are not the conceptions of theory as claimed by Dr. Norman Campbell,[1] but scientific instincts which have developed along with our mental faculties, as trained by and in the pursuit of scientific truth.

To go beyond this in criticism would be distasteful and dangerous, the more so if one bears in mind the excellent advice of Dr. Whitehead, made *à propos* of the Differential Calculus and the way it was launched to the accompaniment of much ingenious but imperfect explanations. He has written[2]:—

> "It is this possibility of being right, albeit with entirely wrong explanations as to what is being done that so often makes external criticism—that is so far as it is meant to stop the pursuit of the method—singularly barren and futile in the progress of science. The instinct of trained observers and their sense of curiosity due to the fact that they are obviously getting at something are far safer guides. The general effect of the success of the Differential Calculus was to generate a large amount of bad philosophy centring round the infinitely small."

Substitute "Relativity" for "Differential Calculus" and "space and time" for "infinitely small," and the above quotation might he read word for word in the present perplexity.

In concluding my remarks on this subject, I must say that, though still intensely inquisitive in the matter of this high and elusive doctrine, I must reluctantly conclude that no help is to be derived from such of the popular attempts at explanation as I have so far seen. Ordinary scientists, the unfortunate plain man and the practical person have no chance here I am afraid. It would seem that there is no royal road to understand Relativity. It must be approached by the same laborious track that has been responsible for its inception and development, namely, by the way of the higher mathematics.

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[1] *Nature*, Relativity Number, 17th Feb., 1921, p. 804.

[2] "Introduction to Mathematics," Home University Library, p. 227.

The problem of the state of mind of those, including the main author of Relativity, who have indulged in these popular explanations, and by means of verbal catachreses have pretended to give (in the words of Einstein) "an exact insight into the theory" is a problem of which I see no possible explanation whatever.

PSYCHICAL RESEARCH.

It is not a little curious that Sir Oliver Lodge, one of the physicists who has severely criticised the Einstein theories, is nevertheless a staunch believer in psychic phenomena and his recent book "Raymond" must be familiar to many. The war and its tragic results have been partly responsible for a great boom in psychic matters, and the ordinary enquirer has more demands than ever made on his time and credulity. Inasmuch also as the subject has occupied a committee of bishops at the Lambeth Conference in 1920, and was also in evidence at the British Association meeting at Cardiff in the same year, it is clear that this much abused and dubious line of investigation. Psychical Research, at the present moment, is claiming more and more attention. It is not a subject included within the Sectional work of this Congress, but, following our model the British Association, there is perhaps no great harm in widening our outlook occasionally. I do not proprose to do more than allude to it here. Its votaries, like the Relativists, are very much in earnest nowadays and are making a wider appeal to thoughtful people, not only by newspaper and magazine articles, but also by means of a new organ, the *Psychic Research Quarterly* (Kegan, Paul, Trench and Co.). I have had access to the first few numbers of this beautifully presented publication, which equals that of any other serious quarterly. Its special appeal to us is that it lays claim to a scientific treatment of psychic phenomena. Some of the phases of the subject therein treated of are as fascinating as Relativity, though in an entirely different way. I shall not refer here to the late Dr. Crawford and the Goligher circle, the Dowsing or Divining Rod, or any specific thing of this sort, but one cannot quarrel with the following remarks by Dr. F. C. S. Schiller in Vol. I, No. I, of July 1920, which conclude his plea for a fair examination of the whole subject:—

> "It will long be necessary to verify most carefully every assertion on either side and to presume that every bit of evidence has

> been polarised by prejudice until the contrary has been shown. It follows that under such conditions no test can be made really convincing except the most exacting of all, the pragmatic test: the world at large will not really and truly believe that mind can communicate with mind directly, or that the departed are not really dead, until the *routine* of ordinary life includes the sending and receiving of telepathic messages, and of communications from (and to) the "dead," which shall be so common and so well authenticated by their consonance with their earthly personality as to leave no practical doubt that they are what they claim to be, and *not* the work of self-deception, subliminal memories, devils or cosmic Absolutes. Or, in other words, until the ultra-physical world has been rendered continuous with the world we live in, and this world and the "next" practically interpenetrate."

Inasmuch then as this strangely acquired knowledge claims the right to be tested by the touchstone of scientific investigation, it must take a part in our fuller professional life whether we will or not From the point of view of a rather sceptical looker-on, I freely admit the claim and the possibly supreme interest of the matter; but I foresee an endless and bitter struggle in the elimination of fraud in any such investigations. Frail humanity is always to be suspected in any dealings with the marvellous, and the skill of those who apply themselves professionally to deceive is greater than most people think who have not studied the resources available to the twentieth century magician or conjurer.

I would also refer just for a moment to an article by H Stanley Redgrove on "Mathematics and Psychical Research"[1] where he proposes to introduce the reader to the mathematical symbolisation of spirit, or the relation between matter and spirit. He does not here discuss the theory that spirit transcends the limitations of matter by a fourth dimension (an old idea), nor does he hark back to the idea of the Kabalists and Chinese philosophy that numbers are essentially symbols "enshrining a hidden meaning and significance," but he suggests that, just as physical existence may be symbolised by real numbers, so may corresponding spiritual existences be symbolised by corresponding "imaginary" numbers And he does this fully recognising the other uses to which imaginary numbers have been put. It is not quite clear exactly what is gained by this symbolism, but it appears that Einstein's example of utilizing the imaginary expression $\sqrt{-1}$ as a factor of the time co-ordinate, thereby converting it into a sort of spacial direction, makes the author of the above paper enquire "does this account for the fact that time appears to us to be so very different from space? Does it mean that time is related to space in a manner similar to that in which spirit is related to matter?"—an answer to which question I think will not be easily found.

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[1] *loc. cit.*, Vol. 1, No. 3, p. 220.

This is all I can find time to say here about Psychic Research, except that, in widening our outlook in regard to this borderland aspect of science, we may well be stimulated by the following taunt by J. Paterson-Smyth [1] in his reference to spiritism and spiritualism:—

> "We are a strange, dull people, we humans An unthinking crowd at the gate of unutterable mysteries. There are wondrous things ahead, but the people do not know it. There is no death, but the people do not believe it. Human life is the most exciting romantic adventure in the Universe going on stage after stage till we are older than Methuselah, and then on again through the infinite eternities—and yet men pass into the Unseen as stupidly as the caterpillar on the cabbage-leaf, without curiosity or joy or wonder or excitement at the boundless career ahead."

PSYCHOTHERAPY

Another aspect of psychical science, and one that has a more directly practical aim, is the use that the new psychology (as it is called) has been put to in medicine under the name of Psychotherapeutics, Psychotherapy or Psycho-analysis. Here we come in touch with a novel method of treatment for the mentally deranged; a method that seems likely to open up an extensive field to experimental research. As we have a Medical Research Section in this Congress, I have less scruple in drawing attention to it in this address as being another borderland aspect of science now prominently in the public eye, since the war has left us with so many neuroses and psychoses as a sad legacy Also it appears to be a fact (which I have on good authority) that many of the everyday disorders, which were formerly regarded as originating on the physical side are now known to be principally of psychogenetic origin—as is proved by their yielding to psychotherapeutic treatment. The principle of the treatment is based on the theory of the New Psychology: that there is a constant war going on in the mind between the primitive instincts (self-preservation and self-perpetuation) and what is known as our Herd instincts, derived from our ideas and views founded on education, religion, social environment, etc , which control, regulate and direct our conduct in everyday life and render us civilised beings. The primitive instincts are ever pressing for recognition and the Herd instincts on the other hand are endeavouring to keep them in subjection and repress them Should the primitive tend to gain the upper hand, conflict is apt to occur and mental anguish and unrest result; and in order to regain mental repose the complex created is treated as a foreign body in the mind and is expelled from consciousness. This repressed-complex has usually considerable emotional force attached to it, which is constantly trying to discharge itself, and such discharge is often effected in the production of some functional disorder (hysterical or neurasthenic manifestations) or the development of a psychotic state with delusions, hallucinations, etc. Here, then. is where the psychotherapeutist or psychoanalyst steps in. It is by digging into the mind, discovering these foreign bodies, releasing them from their prison-house and abstracting their emotional attachment, that the cure of the manifestations produced by them is effected and mental tranquility restored.

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[1] "On the Rim of the World," *loc. cit* , Vol. I, No. 3, p. 250.

A new mental synthesis is at the same time effected, in which are included all those portions of the mind which have been split off and kept out of consciousness by repression. Incidentally I may mention that it is supposed by some that, if mediumistic trance may be regarded as a neurosis, psychoanalytical methods of research into the mind of a medium would tend to 'cure' the medium of his gift for trance manifestations. if it were not for unconscious resistances set up, which may be so great as to be insuperable.

I cannot pursue this further here, nor say much about how the digging out of the foreign body, the repressed complex, is effected ; but dreams and their interpretations and word associations and their time reactions are prominent features In the latter method the words called out sometimes yield such long intervals before the answering word is given that they constitute what are known as 'complex indicators.' These again are of special interest in connection with psychic research ; for in the case of those who believe in super-normal acquisition of knowledge by mediums by means of telepathy with the living or the dead, it is contended that the complex indicators may be used to define particular personalities so distinctly that they might be recorded and classified like finger prints for identification purposes.

Returning to psychotherapy, I understand that in the near future it is hoped to establish in England clinics and give facilities for patients to be treated in the earlier stages of mental disorders, so that the development of an acute attack may be avoided. The Ministry of Pensions, Medical Service Division has now several institutions under their control where this modern treatment is being successfully carried on, and developments are taking place to provide similar treatment in the ordinary civil institutions in the country.

I do not know that much is doing in this line in India yet. Perhaps the Indian is individually less troubled in this way than our western civilisation ; though whether as a race this is true may be open to question, judging by the example furnished by non-co-operation in the matter of the psychology of the crowd. To stray for a moment into wider fields, it might be illuminating to the leaders of the non-co-operation movement if they considered the bearings of the science of the New

Psychology on the 'Himalayan' errors into which they have already been led. Organised stimulation and encouragement of the primitive instincts of the masses of the people towards opposing civil authority and towards racial animosity, until the tide of psychic force has acquired a full head, and then the application of stringent repressions in the form of shibboleths of non-violence, are the one sure way to create those emotional complexes among the people, which, the longer they are repressed the more surely will they in the long run result in mental conflict with outbursts of hysterical mania. And if non-co-operation does not go as far as this, but merely produces a sulky, morose attitude of the masses towards the administration of law and order, it cannot be said to contribute to the sum of human happiness.

An example of a probably not unrelated psychological problem may be found in present-day peace conferences. It seems by no means certain that they are not in error as being too artificially repressive. It were better in my humble opinion to call a conference of the Powers to consider an International Currency, an International System of Weights and Measures and an International Second Language for all, in addition to the private international conferences that have already done much good; by which means the primitive instincts of the nations to quarrel with each other might be gradually sublimated and extroverted into other channels—than to call a Universal Peace Conference and attempt to cover up and damp down these fierce emotions by artificial repressions which can only result in psychic world anguish and this in turn to a world gone mad. Universal peace must be founded on universal good-will and understanding These are the obvious first steps to be taken.

The above briefly referred to Trinity of new conceptions —Relativity, Psychical Research and Psychotherapy—have some features in common; they are concerned with borderland regions extending out beyond those ordinarily embraced in established science, and they constitute efforts to wrest a little more country from the great unknown and add it to the already conquered kingdom of knowledge. As such they require to be considered in any estimate of contemporary science. I have been attracted to them because of these pioneer qualities, and I hope that in venturing to bring them up in your consciousness I have not wearied you

MINERAL AND GEOLOGICAL PROBLEMS IN THE HIMALAYA.

I must now leave the region of theory and speculation and get more into my own groove—the beaten track of geology and mineralogy. More than twenty years ago Sir Thomas Holland (who should have been standing here addressing you to-day) was at work along with me at the geology of this Province, and especially in the Salem and Coimbatore Districts. Although there are many attractive geological and mineralogical problems connected with Southern India, I must regretfully forego all further reference to this part of the country in favour of the Himalayan area, particularly that part of it embraced in the Jammu and Kashmir State, where the last five years of my energies have been absorbed, and where therefore my freshest memories and experiences lie.

One of the first impressions many people receive on viewing the mass of this mountain range, is, that such a mighty rock excrescence must needs be particularly rich in mineral wealth. This unreasoned impression may generally be taken to amount to the more precisely stated fact that more rock —more of the anatomy of the geological formations—is exposed to view in such a mountainous area than in the plains and plateaux of Peninsular India; and with that of course its contained minerals. But, though not exposed, there is plenty of rock to be found underground anywhere: the Himalayas have more of their goods in the shop window, that is all.

As a consequence of the surface relief of these mountains, exceeding that of any other range, there is one mineral (the source of enormous potential energy) ever present in the Himalaya, and one which has hitherto been almost neglected and strangely so in these modern days, and that is the very common mineral, water. Most of the big rivers and many of the larger streams of this elevated tract are snow-fed and perennial, and their steep gradients lend themselves very generally to the utilization of the fall as a source of power. This is every moment slipping away through our hands unregarded. except in a few places such as at Mohura, on the Jhelum, in Kashmir, and at Simla, Mussoorie and Darjeeling. Even then (at the first of these places at least, where only one quarter of the available power is utilized) this power is turned to such relatively trivial purposes as electric lighting, or the uneconomical one of electric heating. One of the great advantages of a mineral of this kind is that its fall only is consumed in generating power, leaving the material itself as valuable as ever for its primary duty of irrigation. Furthermore, the crop of this mineral is renewed every year, so that, so long as the sun, and its consequence, the monsoon, function regularly, we can never exhaust this vein of mineral wealth.

We have reason to hope that neglect of the exploitation of water power has been temporary only. The Hydro-electric Survey of India, instituted in 1918, has already done much pioneer work in the survey of and reporting on suitable sites all over the country, and in ascertaining how much power and along what lines it can best be developed. Among these sites, of course, are the fine sources of power which you possess here in Southern India, as represented by the Cauvery falls, the Hogenkal falls (also on the Cauvery river) and the Gersoppa falls, of which, part of the first mentioned alone has been utilized up to the present. The consequence of the work of the Hydro-electric Survey has been that much more interest has been evinced by expert representatives of leading firms of British manufactures of the class of plant required, and they have been touring the country in order to see for themselves what the prospects are. Applications, also, have been made for the right to develop several particular sites.

Mr. J. W. Meares, Electrical Adviser to the Government of India, in an article contributed to the *Journal of Industries and Labour,*[1] has pointed out that hydro-electric schemes, besides being concerned with electric lighting and electric fans, have a far greater future in the driving of mills and factories, in the electric furnace, the arc and the electrolytic cell; the most important processes being the fixation of atmospheric nitrogen into the nitrates of commerce, the production of aluminium from bauxite, use in the steel industry, and in the manufacture of carbide of calcium and several other substances that can profitably be produced electrolytically.

If adequate advantage is not taken of our Himalayan abundance of this 'white coal,' future generations may well look back to the present period with wonderment that we should have allowed all this energy to be wasted, or worse than wasted, in carving and cutting away the foundations of its own potentiality (*i e.* wearing down its own river-bed), instead of setting dynamos in motion for a hundred useful purposes.

Coming to a consideration of minerals, as commonly understood, and, for the present, of those of fundamental value, namely, coal and iron—all Himalayan areas are handicapped by their poverty in the former commodity, which is represented over a portion of that area by one, and only one, thin bed of a few feet thickness. This belongs to the youngest era of geological chronology and is the equivalent of the coal of Dandot and other Salt Range fields. Nearly everywhere else the older geological series, corresponding to those of the well-known coal-fields of the Peninsula, yield no coal, with one exception near Darjeeling, in Bhutan and Northern Assam. If carbonaceous representatives occur, they are apt to take the form of graphite. It seems that the pressure and crumpling, to which the older rock series of the Himalaya have been subjected, during and since the periods of upheaval of the range, have driven off the volatile constituents of those once potential fuels, leaving little but pure carbon as graphite; a mineral that has its own specific uses, but fuel is not one of these. Without abundant coal of a particular quality iron is of little use at present, and its value may be considered as negligible, except for purely local needs. In regard to all such heavy and not intrinsically valuable metals, mountainous regions are always at a disadvantage as compared with regions more accessible to rail and road facilities.

The Himalaya as a whole, likewise, are poor in mineral veins, using the term in the strict sense of infillings of ore in what were once cracks and fissures in the rocks. This poverty, like the poverty in coal, may also very probably be ascribed to the compression and folding of the rock mass of the mountains, which has gone on fairly uninterruptedly for geological ages and left no fissures or gapes in an open condition and ready for the reception of the class of ores usually found in mineral veins

In all other kinds of mineral occurrences, such as those generated by deposition, concentration and segregation, and which take on the aspect of bedded and banded rock strata and masses, as well as those due to pneumatolytic action and possibly to metasomatic replacements, certain parts of the Himalaya can be shown to be reasonably favoured.

The north-western parts of this range, and notably the area composing the territories of H.H. the Maharaja of Jammu and Kashmir State, have, during the last few years, been under special examination by the Mineral Survey, with fairly satisfactory results. Apart from the precious and semi-precious minerals, such as alluvial gold and the gem stones, sapphire, aquamarine, rubellite, tourmaline, and so on, about which all that has so far been accurately surveyed has been published at least in a certain amount of detail, there remain several other noticeable mineral deposits, which have so far not emerged into publicity, though accounts for the use of the public, printed by the State Press, are in course of preparation. It may interest you to touch briefly on some of these.

Petroleum Oil Belt

I will refer first of all to the possibilities of an extension into this area of the oil-field conditions represented by Khaur. With the contemplated early entry of this oil-field into the actively producing stage during the present year (1922) as soon as the refinery at Rawalpindi is completed, and with the consequent changes of an economic nature that it will bring about in those parts of India where coal and other solid fuel is not very abundant, there arises the vital question, is that field (or that field supplemented by the neighbouring field of Dhulian, both of which are being developed by the Attock Oil Company) the only one belonging to this oil belt likely to yield commercial quantities of oil ? On general grounds one would hardly expect the answer to this to be in the affirmative.

A possible extension of the belt into Jammu Province has already been discussed by me in a paper in the *Records of the Geological Survey of India*[1] describing the Nar-Budhan dome; but since that time other as yet unpublished evidence has come to light. It is no part of my idea in this address to describe technical details that more fittingly would find a place in the Section devoted to Geology, but I may say here that another semi-dome, or 'terrace,' of very large size, occurring in formations of the same geological age, has been identified by the Mineral Survey at Ramnagar in Jammu Province, and that, besides the discovery of two gas seepages in the neighbourhood, the rocks at the actual semi-dome have yielded a considerable fauna of vertebrate remains which correlate them exactly as regards their geological age with the Chinji stage as developed at the Khaur oil-field. The work of identification and description of these fossil remains is now in the hands of Dr. G. E. Pilgrim, of the Geological Survey of India, and it is hoped that, apart from yielding evidence as to the age of the beds, the teeth and bones themselves will have an interest to palaeontologists on account of their containing specimens of anthropoid apes similar to those already described from other localities by Dr. Pilgrim. Other evidence, making the possible extension of the oil belt in this direction even more plausible, is the discovery in Poonch State by Mr. Wadia, of the Geological Survey of India, of an extensive outcrop of bituminous limestone in the underlying Murree Series.

Further explorations of the Jammu areas and also of the long known area of seepages near Golra, north of Rawalpindi, are in progress at this moment It is fervently hoped that the arrival of the Khaur field at the producing stage will be the signal for a renewed interest in all the surrounding areas; for it is very unlikely that a single group of wells at that one place will be allowed to stand as the sole representative of the effort of industry to tap the underground resources of this north-west oil belt.

Bauxite.

My next reference is to the bauxite deposits of Jammu Province. These were discovered and have been under investigation during the last few cold-weather field seasons. The deposits taken as a whole constitute a large and extremely interesting occurrence because the composition of the ore differs in some remarkable ways from that of any other bauxites found in India; and at the same time their geological history is equally peculiar and interesting. In the area in which the deposits are found, the infranummulitic rocks include, at a depth of about 60 ft. below the coal of these parts, a pisolitic and sometimes ferruginous clay, which in turn lies superpositionally on a ferruginous breccia or brecciated quartzitic grit, and this again covers unconformably the 'great limestone' of unknown age. Besides lying below the coal, it is very probable that the pisolite is contemporaneous with it, inasmuch as at one place it passes laterally into coal for a short distance.

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[1] Vol. XLIX, pt. 4, 1919.

The folding of the rocks in conjunction with the hill contours, in certain places such as Chakar, Sangar Marg and Salal Fort hill, has resulted in large spreads of this pisolitic and clayey rock being left as a skin lying on dip slopes of varying steepness and uncovered by any of the overlying formations. This is of course a mere physiographic coincidence, but one cannot help seeing a certain superficial resemblance between these spreads and the lateritic bauxite plateaux of other parts of India, a resemblance that is carried out as well in the average thickness (about ten or twelve feet) and in the cliff-like way in which the outcrops end. The particular feature that gives them value as a source of alumina is that, wherever this skin or spread of clayey rock is sufficiently isolated from its overburden, and left clinging to rather steep slopes, its upper layers have been converted into a residual white pisolitic or compact bauxite, having a composition akin to that of diaspore ($Al_2O_3 . H_2O$). Its lower layers, by gradual increase of silica pass into white or creamy white kaolin as also do the layers that are not isolated on dip slopes but pass underground beneath the overlying strata.

Detailed surveys and a large number of chemical analyses of systematically collected samples have been made of the bauxite layers, which show that considerable amounts have a composition as follows :—

Alumina	70 to 80	per cent.
Silica	1 to 10	,,
Titanic acid	2 to 4	,,
Ferric oxide	2 to 4	,,
Water	13 to 15	,,

From this it will be seen that in its richest form, save for the 2 or 3 per cent each of titanic acid and ferric oxide, this bauxite corresponds with the mineral diaspore, which has 85 per cent alumina and 15 per cent water; whilst the less rich varieties may be regarded as diaspore mixed with varying proportions of silica combined with alumina as clay. Ordinary bauxite, which usually has considerably more iron impurity, about 50 to 60 per cent of alumina, and much more water, reaching 28 to 30 per cent, as in the best American bauxites is generally looked upon as an impure mixture of diaspore ($Al_2O_3 . H_2O$) and gibbsite ($Al_2O_3 . 3H_2O$); and it is less hard and less dense and more soluble than the Jammu material. It seems probable that, in the ordinary processes in use for the manufacture of aluminium, ordinary bauxite is more adaptable than the Jammu bauxite, but regarding this matter enquiry is still being continued: for it seems a pity that such a rich ore should lie idle for want of a suitable process being available for converting it into the metal. Failing this, however, there are many uses to which it can be put that I need not trouble you with here. For some of these processes a hydro-electric installation close by in the gorge of the Chenab River, where excellent facilities exist, would be desirable. The locality has already been under examination from this point of view.

From a number of analyses of foreign bauxites collected together by Mr. C. S. Fox, of the Geological Survey of India, for his Memoir on bauxite now in preparation, and kindly furnished me by the Director, it is of great interest to note that, of all the bauxites of the world, those from many parts of Southern France, especially from Villeveyrac, Les Baux, Herault, Thoronet, Gardanne (Bouches-du-Rhone), La Brasque, as well as some from Dublin, Ireland, and perhaps from Wochein (now apparently) in the corridor between Italy and Jugo Slavia) alone have a chemical composition similar to that of my Jammu bauxities, that is to say, having an alumina percentage as high as 70 to 80 and a water percentage in the neighbourhood of 14 or 15.

It is also a striking fact that, as regards geological age, those of Southern France agree (within certain limits) with the Jammu instances. For, as regards the former, it seems, from the researches of L. Collot,[1] that although there is a great deal of apparent irregularity in their horizon as between Urgonian and Nummulitic, the actual horizon must be definitely placed between Urgonian and Cenomanian. Whilst, as regards my Jammu bauxites, it is clear from their association with the coal that they must be equivalent in age to the pisolite and coal of the neighbouring area of Hazara,[2] which definitely comes *above* the Cenomanian as determined by a clear suite of cephalopod fossils there found.

Into the further question as to whether there is or is not any relation between the Jammu bauxites and those of lateritic origin in Peninsular India, I can hardly venture in this address. I have not seen Mr. Fox's conclusions: so I must confine myself to suggesting that the very late age generally ascribed to the high-level laterites of India (because they are now the uppermost visible formation below the alluvium) namely, Sub-recent, Pleistocene or perhaps Pliocene, may after all be an error. For, since the whole of the Tertiary system apparently was never deposited over Peninsular India, that series might equally well be ascribed a position *above* the laterite as *below* it. The question is a big one and might well occupy an address in itself, so I must be excused from saying anything more about it now.

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[1] Bull. Soc. Geol. France, Vol. XV, 1887.

[2] Mem. Geol. Surv. of India, Vol. XXVI, 1896.

There is just one more matter of theoretical interest connected with these recently discovered Jammu bauxites, in virtue of the composition of the latter being nearly pure diaspore or mono-hydrate of alumina: this is. the question whether the sapphires of Padar in Zanskar, which are known to occur in a granite matrix with Nummulitic limestone forming the craggy heights above, may not owe their origin to contamination of the granitic magma with included masses of diaspore rock picked up from the infra-nummulitic rocks in that region. The idea seems a good working hypothesis, but I have had no opportunity as yet of testing it on the ground.

Gypsum.

The last mineral I have selected to say a few words about is the gypsum of the Jhelum Valley in the tehsil of Uri. One reason why I have chosen this mineral out of several others that have an equal or better claim to your attention, is that it exists in such enormous—almost fabulous—quantities. It is no exaggeration to say that in the hills and valleys just north of Mohura Power Station there lie hundreds of millions of tons of this beautiful snow-white or wax-white mineral which frequently has the additional qualities of alabaster, and can be turned on the lathe or carved into all sorts of exquisite objects. Another reason is that some of the modern uses to which it is put in various industrial directions seem to promise a future for it of as yet unknown importance.

The gypsum occurs in two well-defined bands running E. and W. across a number of steep secondary ridges and spurs descending from the Kaz-i-Nag range down to the valley of the Jhelum between Uri and Rampur. It is associated with a set of graphitic schists, which are nearly as remarkable as the gypsum, in that they, over a distance of many miles, yield about four million tons of amorphous graphite to the half mile of outcrop down to water level Unlike the gypsum of the Salt Range which has been supposed to have a sedimentary or evaporative origin, the gypsum of this part of Kashmir is plainly an alteration product of limestone; brought about by means of the sulphuric acid liberated from quantities of minute crystals of pyrites disseminated in the limestone Whole hill-sides rising thousands of feet above the valleys are composed of gypsum, and it is easily available in cliffs and scarps of 60 to 100 feet in height to simple quarrying operations

In considering this mineral from an economic point of view, I do not want to describe the ordinary uses to which it can be put, such as alabaster, plaster-of-Paris, wall and ceiling plaster, whitewashing, plaster board and gypsum wall board, gypsum blocks (which owing to the greatly increased cost of fuel everywhere compete favourably with terra cotta, since the fuel required to manufacture a ton of calcined gypsum is small compared with that required to burn an equal amount of terra cotta), nor do I want to speculate on the making of sulphuric acid from it (because during the stress of the great war the Germans actually did manufacture many thousands of tons of acid from gypsum or because of sensational reports from Bombay that appeared in the papers of June 1919 regarding an easy and cheap process for this purpose in India).

Some new facts have recently come to light in America regarding the use of it in agriculture, and it is these to which I wish to draw your attention for a few moments before I end this address.

Gypsum, simply ground without any other treatment, has long been known under the name of 'land plaster,' and used as a fertiliser or soil stimulant. This was formerly explained by showing that the application of it increased the amount of potassium taken up through a double decomposition of potassium silicates with liberation of potassium sulphate. Thus the action of gypsum was supposed to be only indirectly beneficial. Other explanations of its physical action on particular soils, such as those containing 'reh' by facilitating soil percolation, are given in Watt's "Commercial Products of India."

But this apparently does not represent the case by any means fully, for researches in recent years by E. B. Hart and W. H. Peterson [1] of Wisconsin, followed by O. M. Shedd [2] of Kentucky, P. E. Brown and E. H. Kellogg [3] of Iowa and Reimer [4] of Oregon have shown that sulphur is absolutely necessary to plant proteins, and that the sulphur content of most farm products is much larger than had been previously suspected. It was also found that the amount of sulphur trioxide removed from soils is also considerable, being for average crops of cereal grains and straws 2/3 of the phosphorus pentoxide removed, whilst grasses of mixed meadow hay removed an equal quantity of each, and members of the crucifers, e.g. cabbage and turnip, are heavy sulphur using crops and may remove two or three times as much sulphur trioxide as phosphorus pentoxide.

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[1] "Research Bull." No. 14, Wisconsin Agricul. Exp. Sta. 1911.
[2] Do. No. 174, Kentucky Do. 1913.
[3] Do. No. 18, Iowa Do. 1914.
[4] Do. No. 163, Oregon Do. 1919.

The reason why this was not appreciated before is that previous calculations were based on the ash of the plants determined by ignition, which, however, gives too low an estimate, this being particularly true of the seeds, where the sulphur exists largely in the organic form in the protein molecule: for instance in rice grains there is 100 times as much sulphur trioxide as in the ash of that grain and forty times as much in corn and wheat grains as in their ash.

Cropping and drainage remove such quantities from the soil that, after fifty or sixty years, virgin soils unmanured or receiving but slight application during that period lose 40 per cent of the sulphur trioxide originally present. Normal soils again are poor in total sulphur trioxide. Consequently it should be applied occasionally as sulphate for the express purpose of maintaining in the soil an adequate supply of this element for crops rich in proteins.

It is known that plants require the sulphur in the form of sulphates, and this is effected in the case of organic sulphur compounds by a process which embraces first the production of hydrogen sulphide by the means of ordinary decay bacteria, then the change of this to free sulphur and then to sulphates by a special set of what are now known as sulphofying bacteria. The sulphates thus produced are taken up by the plant proteins and thus a sulphur cycle is completed, just as is a nitrogen cycle, in plant economy.

It now seems certain, after years of further experiment, especially in Oregon by Reimer, that sulphur must be claimed as an exceedingly important plant food, and that all or most of the benefits derived from acid phosphate can be secured by using gypsum, and a 50 per cent saving be made at the same time. This artificial addition of sulphate, e g. gypsum, to the soil also encourages the sulphofying bacteria to work more energetically; and, that it additionally increases the growth of the nitrogen-fixing bacteria, seems established.

The following statement briefly summarises a few concrete results (Mineral Industry, 1919, p. 332):—

> "Gypsum increases the protein content in legume hays (alfalfa, clover, etc.). Professor Peterson at Wisconsin found that land plaster more than doubled the protein in alfalfa. Reimer concludes that the feeding value of alfalfa hay from sulphur-fertilised plots, without taking into consideration the increased yield, was sufficiently greater to pay for the fertiliser used.
>
> Professor Reimer found that the "root system of alfalfa fertilised with gypsum and other sulphur fertilisers" is from two to three times as large as that from the unfertilised plants. The value of this larger root system is obvious.
>
> As in the past most of the agricultural gypsum sold was used on the pea-nut crop in the south-eastern States; but several thousand tons were sold to alfalfa growers in the north-west, where its use is comparatively new.
>
> Small tonages were scattered through a great many sections for the first time during 1919, and the results secured were so

> **satisfactory that a steady increase in the use of agricultural gypsum is expected."**

In view of the enormous quantities of this useful plant food in Kashmir, it seems reasonable to advocate its use or at least trial on an extensive scale in local agriculture.

Section of Agriculture.

President:—RAO SAHIB M. R. RAMASWAMI SIVAN, B.A., DIP. AGRI.

Presidential Address.

SCOPE OF AGRICULTURAL RESEARCH.

I take it that every one of you is as much disappointed as myself, that Rai Bahadur Ganga Ram, the President-elect of the Agricultural Section, has not been able to come here to-day. Looking over the list of gentlemen who presided at this section in previous years, I find that they were heads of Agricultural Departments in India. Rai Bahadur Ganga Ram, however, is a retired Government official and a clever Engineer by profession. After his retirement, he obtained large areas of land from Government, which he cultivated by comparatively more improved methods, and he utilised his knowledge of Engineering to agricultural purposes, by promoting lift irrigation by steam and electric power. In fine, for nearly 20 years after his retirement, he has been a successful Agricultural Engineer and a business farmer. He is known to be a public spirited gentleman, having endowed scholarships and prizes at the Agricultural College in Punjab and having given very large donations to the Benares Hindu University. He has been apparently a trusted Government servant, being a Companion of the Indian Empire and a Member of the Victorian Order apart from his Rai Bahadurship. Those of us, therefore, who came to the Congress with the expectation of profitting by the advice and suggestions of a business farmer are thoroughly disappointed and you, gentlemen, have probably a further disappointment in store, in that the section is to be presided over by myself. I have neither the departmental experience of past Presidents, nor the practical experience of a business farmer. To add to this, I was called upon to undertake the duties of the President of this section only last evening. That accounts for my inability to deliver an address worthy of the Presidential chair, for instance, a review of "the progress of Agricultural Education" or "progress of Agricultural Chemistry" or any similar subject on which, with plenty of leisure and necessary books of reference, I could probably have prepared one. Under the circumstances, I crave your indulgence for a few minutes when I propose to say a few words on the *Scope* and *Limitations of Agricultural Research.*

Research of all kinds demands in the worker, a sound knowledge, a quick perception and a wide imagination, but Agricultural research, in addition to the above, is beset with peculiar difficulties. First of all, it has to be remembered that Agriculture is but an Art, namely the art of producing crops and it includes the rearing of domestic animals; but the practice of this art is governed by the application of a number of sciences, even a greater number of sciences than there are sections in this Congress. An intimate knowledge, fairly of a high standard, is demanded of a research worker, of all these sciences. Such wide acquirement of knowledge being impossible in these days of rapid scientific progress, specialisation has come in, and Agricultural research requires, therefore, the coordination of the intellectual energies of a number of scientists Now this explains why some Provinces which have a full complement of scientific experts have gone ahead of other Provinces not yet fully staffed.

The second important point in which Agricultural research differs from other researches, is that almost everyone knows something of the art in this land of hoary traditions, wherein Agriculture has been the backbone of the country and the most universally followed pursuit. The researcher has more often to learn from the illiterate cultivators than teach them Indian traditions of cultivation cannot be lightly set aside by these multicoloured scientists in their eagerness to apply their sciences to the art.

Thirdly, the conditions for the carrying on of Agricultural experiments are mostly outside the control of the scientific worker. Soils vary from place to place in their physical and chemical characters, one season is not like another in rainfall, temperature and other climatic conditions, that experiments have necessarily to be repeated several times, in several places and in successive years before trustworthy results can be obtained; and let it be remembered that there is always the chance of negative results being obtained in any experiment. Even when, what appear on the surface to be, reliable results are obtained from experiments in the field, there is the question of probable error to be solved.

When we realise that a world-wide war was necessary to stimulate scientific research, in general and Agricultural research in particular, in Great Britain, it is no wonder that there is a lack of faith in science and scientific methods in this country and that there is a clamour for expeditious results from the public, including the members of the Legislative Councils. It is only when reliable results have been obtained, that the scientific expert offers these results, through the agency of the District Agricultural staff, for adoption by the actual cultivators, and I need not lay stress on the difficulties experienced by these District Agricultural officers in their attempts to disseminate these ideas in the villages. In a word, their duties have all the charm and disappointments of a missionary worker.

While the majority of the members of the Legislative Councils have been conciliatory, even magnanimous, in their budget discussions when dealing with the development of the Agricultural Department, a few cries are heard here and there, that the Agricultural Departments are white elephants We often hear of criticisms that the researches of a scientific worker are more often of an academic nature than of any economic importance. Most researches are probably in the beginning only of an academic kind, especially to the on-looker, but they train the intelligent mind of the worker for deeper insights into the hidden problems of nature. I am only voicing the opinion of the greatest scientists of the day when I say, that harassing the researcher to produce quick results and economic results, ends either in damping the spirit of the worker or in his producing haphazard work. So long as the experimenter is imbued with the true spirit of research, namely the spirit of discovering and evolving truths of nature and so long as he is qualified, by his knowledge and training. to undertake research work, a research worker may be left in peace; for it is *in his nature and to his interest* to carry on his work as quickly as possible, if not for the benefit of humanity at least for the winning of his own laurels in scientific circles.

Granting the above conditions of the scope of Agricultural research, the next question arises "Are we going on right lines?" I believe we are. We are following generally the methods adopted, with success, in countries where science has made rapid progress, and as they have succeeded in those countries, we have to take it that we will succeed in ours, so long as due consideration is given to local conditions. That brings us to the agency and we are grateful to the experts who have worked in this country from abroad. Some of us, at any rate, have had a training from them and we are therefore welcoming the Indianisation of the department in the higher services which has already come and which will come in greater measure in the near future. Let me beg of you, gentlemen, to remember that this Indianisation connotes increased responsibilities. Where formerly we were content to be certified to as efficient assistants, capable of carrying out orders, we have now, as responsible heads, to think, to design and to direct. I, for one, have always held the opinion that this land, which can boast of a highly cultured civilisation dating from ancient times, and of literature and systems of philosophy in no way inferior to those of other countries, is in no way deplete of master minds who can think, design and direct. I appeal to you and I exhort you, younger members of the Congress, to remember that, as patriotic sons of India, it is your duty to render a good account of yourselves and produce such work commensurate with the money spent, on you and your researches, from the pockets of the cultivators. We have been paid for in cash by them and let us remember that it is an obligation on our part to return in kind in the shape of useful scientific work.

I will put the above ideas once again in one or two statements which I commend to every one. We have plenty of facilities Utilise them to the best advantage. If any one should think that he is not paid sufficient wages in proportion to his talents, he has the option of resigning. When, however he has chosen to remain, he should put the question, to be answered by his own conscience, "Is this all I can do?" rather than be satisfied with "This will do."

Gentlemen, I have done: but before I ask you to listen to the papers announced, I would like to say a few words regarding the paucity of papers submitted to this section. It is possible that Rai Bahadur Ganga Ram did not think of taking the trouble to write to Agricultural officers in different parts of India to exert themselves in getting papers ready—a procedure which was adopted by Presidents in some of the previous years. Again it has to be remembered that practically all the research work done by departmental officers find their place in departmental publications, for instance, Memoirs and Bulletins of Pusa. Provincial Year books and Bulletins and Agricultural Journals. Again in each Province there has been an Agricultural Conference of some kind or other at which Agricultural officers generally take part; for instance, we had at Coimbatore, only last month, our Agricultural Conference, at which 8 or 9 good papers were read And lastly some papers seem to have been sent to the Secretaries too late for being included in this year's programme, and I am glad to announce that I have the permission of the Committee of the Science Congress to use my discretion in allowing such papers to be read, and I shall be glad to exercise that privilege.

Gentlemen, I am thankful to the Committee of the Science Congress for electing me officiating President of the Agricultural Section, and to you, gentlemen, for the patient hearing you have given to my hastily thought out ideas

Sugarcane Root—systems—studies in development and anatomy.—*By* T. S. VENKATARAMAN *and* R. THOMAS.

Need for a systematic study of roots in all plants and particularly in cultivated crops.

The root systems of certain avenue trees in relation to adjoining crops.

Effect of environmental conditions on root development in sugarcanes.

Rapidity of root development in different cane varieties.

Studies in plan of development or the habit of roots in the different sugarcane varieties:—

(1) Methods of study.
(2) Crossing in sugarcane with a view to improve the type of root system.

Certain anatomical differences—possible adaptations to environmental conditions in the habitat.

On some insects noted as pests of fruit trees in S. India.

—*By* T. V. R. AIYAR.

The very interesting and suggestive pamphlet published by Sir Frederick Nicholson on "A plea for the encouragement of a fruit growing industry in the Madras Presidency" should certainly make both landed proprietors and the Government to bestow more serious attention to this aspect of agriculture in S. India, *viz.* fruit culture. There are a few well-known fruit growing tracts famous for different fruits such as Salem, Chittoor and Northern Circars for their mangoes, Krishnagiri Penukonda and Michaelpatti for their grapes, Erode and Palneys for their bananas, etc., but for a tropical tract like the Madras Presidency where the possibilities and potentialities of such an industry are enormous, these are comparatively very few and insufficient, and in many cases the work is carried on with very little system or organisation. It cannot be denied therefore, that the industry as a whole is capable of considerable extension and improvement in all ways. Government have already made a beginning in this direction by starting small fruit farms on the Nilgiris to begin with. Now that such a beginning has been made by Government, and as it is not unlikely that landed proprietors too will start on the same lines, it will be found necessary that the subject of fruit culture should be closely and thoroughly studied in all its aspects so that all such attempts might progress successfully. In this paper an attempt is made to bring together and present in a very brief manner our present knowledge of the Entomological side of fruit culture in S. India.

In spite of the absence of any extensive fruit culture in S. India approaching anything existing in the well-known fruit growing countries like California, Australia or S. Africa, it is a matter of common knowledge that just as our field crops like paddy, sorghum, etc., are subject to the attacks of insects, fruit trees are also liable to the undesirable attentions of insects of sorts. It is believed, therefore, that, to one who is anxious to carry on fruit growing on a fairly extensive scale on scientific lines, a knowledge of the insect pests that have so far been found to do some appreciable amount of harm to our native fruit trees will be of some real use side by side with the knowledge of the other aspects of fruit culture, such as, soil, manures, irrigation, varieties, etc., etc. The information brought together in this paper is necessarily and admittedly imperfect for obvious reasons; in spite of this, the writer hopes that it might form a small beginning to start with in the direction of Pomological Entomology, and might be of some help to prospective fruit growers.

Numerous insects of various habits have been noted on the common fruit trees grown in the different parts of South India. Of these some have been noted to cause appreciable harm while others have so far behaved only as insects of minor importance. In this brief paper only those of the former category about which we have some definite knowledge are included while those of minor importance and others of which our knowledge is imperfect have been omitted. In the paper brief notes are added on some of the important insect pests of the common native fruit-trees of S. India such as the Mango, Jak, Orange, Banana, Pomegranate, Guava, Fig, Grape, etc., and also of what little is known of the pests of introduced fruit plants like Apples, Pears, Peaches, etc.

The worst pests of S. Indian fruit trees as far as our present knowledge goes may be put down as different kinds of stem boring grubs, fruit flies, leaf hoppers, leaf caterpillars, scales and mealy bugs; each particular tree has often its own specific insect pest. Then follow some remarks on the general principles upon which are generally based most of the control measures that might be adopted against such insects and suggestions are made as to the materials that might be stocked by gardeners for pest control.

At the end a warning note is sounded regarding the necessity for prompt and thorough action in the matter of preventing the introduction into the country of undesirable foreign pests with consignments of nursery stock, fruits, tubers, etc., that are imported in large quantities nowadays. The author has given a list of the more prominent foreign pests in a paper he read at the Bombay Session of the Congress.

Pollen sterility in relation to vegetative propagation.—*By* P. S. JIVANNA RAO.

Pollen sterility is a regular feature of plants that are vegetatively raised and the subject is of importance economically as it explains the shedding or abortion of fruits in a large number of instances.

Flowers of about thirty different plants were examined to ascertain the extent of sterility in them and the list includes some grasses and plants that propagate vegetatively in nature and a few grafted trees besides other plants that are raised from cuttings.

The author concludes that it is wrong on principle to propagate crops like Pepper, Cardamom, Vanilla, Moringa and others which are valued for their fruit or seed solely by vegetative means and suggests that suitable modifications may be introduced in the current methods in the case of these and other monogenically reproduced plants so as to ensure retention of full vigour in them

Studies in mehods of preventing nitrogen losses from Cattle Dung and Urine during storage.—*By* N. V JOSHI

Determination of losses in nitrogen from cattle dung and urine under different conditions of storage were made and methods to prevent these losses were studied in the laboratory. The results of the investigation may be summarised as follows:—

1. The losses of nitrogen from the cattle dung when stored separately are small under both aerobic or anaerobic condition of storage.
2. In the case of urine great amounts of nitrogen are lost under aerobic conditions, while under anaerobic conditions the losses are practically nil.
3. Covering the surface of the urine with a layer of some kind of oil like kerosene, mustard or cocoanut brings about the necessary anaerobic conditions and this method has proved effective in preventing losses of nitrogen from the urine.
4. Among several substances tried to prevent losses of nitrogen from urine occurring under aerobic conditions of storage, Sulphuric acid, Superphosphate and Formalin have proved effective but their cost is expected to be prohibitive in practice.
5. Very great losses of nitrogen have been observed when straw and soil were used as absorbents for urine. These absorbents would therefore not prove of value in conserving the nitrogen of the urine.
6. Since greater losses of nitrogen occur in the mixture of cattle dung and urine, it is advisable to store cattle dung and urine in separate pits instead of storing them mixed together in one place.

Availability of the Trichinopoly Phosphatic nodule as a manure for Paddy.—*By* M. R. RAMASWAMI SIVAN.

In the year book of 1918 of the Madras Agricultural Department, a descriptive account of the phosphatic nodules of Trichinopoly has been published in which the author pointed out that the mineral contained too much of lime and also of iron and alumina to be economically manufactured into superphosphate, and that the best method of utilising it would be to grind it fine and apply the flour phosphate along with decomposing organic matter to paddy soils most of which, in the Madras Presidency, were deficient in phosphoric acid as revealed by the soil surveys. A number of investigations were carried out for the last 4 or 5 years to determine the actual availability of this mineral phosphate under swampy paddy soil conditions. While the complete work is being written up, in detail, for a later departmental publication, some aspects of it are presented now to the delegates of the Agricultural section of the Science Congress.

These investigations included the determination of—

(1) the solubility of the phosphate in carbonic acid,
(2) its solubility in different strengths of citric acid,
(3) its availability as measured by citrate solubility in composts made with green manure and cattle manure,
(4) its availability as measured by the growth of paddy plants in pots with and without green manure,
(5) whether increased application of the phosphate gave increased cropping with and without green manure in pots, and lastly
(6) its availability as measured by the growth of paddy in field scale on ryot's lands in conjunction with green manure.

As regards its solubility in carbonic acid and in citric acid, the greater the strength of the acid the more was the phosphate dissolved—a result in consonance with the observations of previous workers.

The amount of phosphate dissolved in ammonium citrate according to the usual official method of heating for half an hour at 65°C was greatest in one week's compost and became less and less in longer kept composts, pointing either to the possibility of the soluble phosphate reverting in the longer kept composts, or the method of analysis requiring modification Probably both the factors are present, as there is over 17% of calcium carbonate in the mineral and as a later method, modified by Dr. Harrison at Pusa, gave increased soluble phosphoric acid on shaking at room temperature instead of at 65°C.

The growth of paddy in pots gave decided results In one series of experiments, the average yield of dry produce was 31 gms. for no manure, 30 gms. for phosphate only, 39 gms. for green manure only, and 48 gms. for green manure and phosphate, indicating that green manure rendered the phosphate available. The soil used for the experiment contained ·005% of available phosphoric acid. Contrary to the results of experiments in the United States of America, increased applications of phosphate from 250 to 1500 pounds per acre gave no increased cropping and it was then surmised that nitrogen might as well be another limiting factor in the soil. In the next series of experiments, this was found to be actually the case, as will be seen from the following table:—

TABLE I.

Showing number of tillerings and yield of grain and straw (Paddy).

Pot No.	Nature of Experiment.	No. of Tillerings.	Weight in Grams of		
			Grain.	Straw.	Total.
1	N	28	13·1	20·9	34·0
2	N and P	29	13·2	19·3	32·5
3	N and 2P	30	16·7	21·3	38·0
4	N and 4P	31	18·2	21·3	39·5
5	N and 8P	29	20·6	22·5	43·1
6	Nil	19	7·4	13·3	20·7
7	P	30	10·7	15·5	26·2
8	2P	30	11·9	15·2	27·1
9	4P	32	12·8	14·0	26·8
10	8P	30	12·3	12·2	24·5
11	G and N	52	26·8	42·9	69·7
12	G and N and P ..	60	27·1	47·5	74·6
13	G and N and 2P ..	62	32·3	47·8	80·1
14	G and N and 4P ..	62	36·8	53 7	90·5
15	G and N and 8P ..	68	36·8	56·6	93·4
16	G	39	24·6	28·1	52·7
17	G and P	42	24·7	33·5	58·2
18	G and 2P	47	26·5	33·3	59 8
19	G and 4P	50	28·1	35·2	63 3
20	G and 8P	50	32·4	35·1	67·5

Note.—P—250 lb. of Flour phosphate G—5,000 lb. of green daincha leaves. N.—400 lb of Sulphate of ammonia.

These results are interesting in several ways. Mere application of phosphate gives lowest yield, but the nitrogen plots yield better, while the green manure plots are better still. The green manure plus nitrogen plots, however, are the best. The results also show that, in addition to phosphoric acid, nitrogen is a limiting factor in the soil. The phosphate is rendered more available by green manure than by nitrogen in the form of sulphate of ammonia. It is also to be noted that there is a small increase in the yield of crop with increased application of phosphate, though not commensurate with the quantity supplied.

Results obtained at the Manganallur Agricultural Station for several years had shown that flour phosphate was nearly as good as bone meal in giving an increased yield of paddy grain. The experiment was tried in different paddy tracts of the Presidency, with the co operation of the Deputy Directors. An approximately uniform piece of land, usually one acre, was selected, evenly manured with green leaves, and divided into 10 long strips. Alternate plots received flour phosphate at the rate of 500 pounds per acre. There was an average increase of 301 lb of grain per acre in the phosphate-manured plots, which works to 11% over the plots manured with green manure only, as will be seen from the following table:—

TABLE II.

Co-operative Field Experiments in Ryot's Lands.

(Manual Experiments with Flour phosphate).

AVERAGE OF 5 EXPERIMENTS
(YIELD IN LBS. PER ACRE.)

Locality.	Green manure.	Green manure and phosphate.	Increase in grain.	Percentage of increase.	REMARKS
	(lb)		(lb)		
Ettapur, Salem District .. (1919)	2,138	2,550	412	19	
Ettapur .. (1922)	3,750	4,060	301	8	
Danishpet .. (1922)	3,603	3,879	276	8	
Elandangudi, Tanjore District .. (1922)	2,102	2,440	338	16	
Central Farm, Coimbatore District (1921)	2,013	2,208	195	10	
.. .. (1922)	2,562	2,843	281	11	
Average ..	2,696	2,997	301	11	

From the above investigations, the conclusion is drawn that mineral phosphate, ground as fine as possible, is a suitable phosphatic manure for paddy lands when applied along with decomposing organic matter. The residual effect of the mineral phosphate seems to be very sensible judged by the experiments at the Government Agricultural Stations, but this is still under investigation

Note.—The paper was illustrated with photographs and lantern slides.

Symbiotic nitrogen fixation in plants other than those of the Leguminoseae order —*By* K. ADINARAYANA RAO.

1. Symbiotic Nitrogen Fixation is not restricted to Leguminosae alone but is a widespread phenomenon.

2. Plants of other orders such as Rubiaceae, Myrsinaceae, Casurineae are instances of the above phenomenon in the tropics, and in temperate regions several others have been enumerated as examples.

3. Chomelia asiatica has now been given in this paper as a further instance of the same phenomenon and Pavetta India has been taken up for comparative study.

4. The leaves of both the species possess on their upper surfaces nodules invariably filled with Bacteria which have been shown to be capable of fixing atmospheric nitrogen.

5. The relationship existing between the Bacteria and the plants examined, seems to be mutually beneficial and it is perpetuated from generation to generation through the seeds since the Bacteria get enclosed in the ovary itself. It has been further noted that the plants are unable to thrive in the absence of Bacteria which have been found at all stages in the life history of the plant.

6 The Nitrogen-Fixation noted compares very favourably with the observations of previous workers.

7. The chief merit of these plants lies, in their being available in unlimited quantities from self-sown jungle trees in almost all the districts of the Madras Presidency and in other parts of India as well.

8. It is a common practice among cultivators to take cart-loads of "Kanuga," "Tangedu," and other leaves from long distances for purposes of green-leaf manuring and the same may be resorted to in the case of Pavettas and Chomelias with profit. The writer is convinced of their value as green-leaf manures since bulk for bulk they contain a higher percentage of nitrogen which becomes available to a much larger extent when the leaves are applied to the soil than for instance "Tangedu" which is so largely used at present as a green-leaf manure.

No.	*Botanical Names.*	*Telugu.*	*Tamil.*
1.	Casia Auriculata.	Tangedu.	Avarai.
2.	Pongamia glabra.	Kanuga.	Pungam.

A historical account of South Indian fungi with special reference to those of Coimbatore.—*By* S. R. VENKATAKRISHNA MUDALIAR.

The earliest mention of the occurrence of fungi in South India is found in the writings of J. J. Koenig, a pupil of Linnaeus who came out to Tranquebar, a Danish Settlement in Tanjore, in 1768. In 1779 he observed a fungus growing on termite nests, probably Aegerita Duthei Berk. Later in 1842 Montagne published a paper on Cryptogamae nilgheriensis in the "Annals" of France. About 1869 Mylitta lapidescens Hor (the little man's bread) and Sclerotium stipitatum Berk at Curr (white ant-hill mango) were observed in the Nilgris and Travancore. The next important fungus recorded for South India is the edible mushroom (Lepiota albuminosa Berk) growing in termite nest

2. Later on, diseases of economic crops of South India attracted the attention of various workers in South India chief among them being those of cotton, coffee, paddy, wheat, potato and tobac o.

3. Soon after the organisation of the Agricultural Department in 1898, the following diseases were investigated: Bud-rot of palmyras in Godavari and Kistna districts, Tikka disease of ground nut in South Arcot and the Red-rot of sugarcane in Godavari and Coimbatore districts.

4 A systematic study of the fungoid diseases was undertaken only after the arrival of Dr. Barber in 899 Since that time the collections of diseased specimens have increased and there are 73 species of fungi found on economic crops grown in Coimbatore alone.

5. A classification of the common fungi found in Coimbatore district gives the following number of species of fungi—42 species of rusts, 11 species of smuts and 19 species of oidium (mildew).

6. Fungi have been observed attacking scale insects found on coffee and pepper. In the field of medical mycology, Madur foot disease, ringworm, tuberculosis are known in South India for a long time.

7. From the above, it is clear, that fungi have been the subject of investigation for over a century and a half in South India.

A Note on the Utilisation of the Spent Mohwra (Bassia latifolia) Flowers.—*By* D. L. SAHASRABUDDHE *and* V. G. PATWARDHAN.

The spent Mohwra flowers produce insanitary conditions in the neighbourhood of the distilleries where the Mohwra flowers are used for distillation. The spent can be utilised by proper treatment (1) as cattle food, (2) for further production of alcohol, (3) for manurial purposes or (4) for burning as fuel.

The fresh material is liked by the cattle and if possible it may be so used but the material becomes mouldy and acid very quickly and therefore it must be squeezed immediately to remove as much water as possible and dried in the sun. The cattle do not like the dry material in the beginning but soon get accustomed to it. The dry spent Mohwra is as good as dry lucerne in its feeding value.

For the production of alcohol the dry material has to be treated with sulphuric acid. The cheapest process would be to hear the spent with twentieth normal sulphuric acid under the atmospheric pressure. The excess of acid may then be neutralised with lime before fermentation. The treatment would increase the yield of alcohol by 2 5%. It has also been found that if the original Mohwra flowers are boiled with twentieth normal sulphuric acid for one hour the quantity of sugars increases by 16%.

These are all laboratory experiments but trials ought to be made on a commercial scale to find out whether the processes indicated would pay.

If the dry spent cannot be used as cattle food or for production of alcohol it may very well be used as a manure or lastly for burning purposes so that the neighbourhood of the distilleries would be free from the insanitary conditions caused by the fermenting spent Mohwra flowers.

Improved method of wheat sowing for Central India.—*By* K. R. JOSHI.

In Central India wheat and other rabi crops are sown by an implement called "Nai" which is the same as the plough, but with a bamboo sowing tube in addition. With the use of this Nai, an area of 1·50 to 2·00 acres is sown per day, and hence in districts where rabi areas predominate, timely sowing of wheat becomes difficult.

In the year 1914—a two coultered Drill was tried for wheat sowing on Indore Farm, and the result was that not only there was a saving in time as expected, but that the Drill appropriated less seed, and still gave higher yield than that of equal areas sown by the Nai. This led to an inquiry into the causes of these Phenomena—when it was found that either shallow sowing, or wider sowing which characterised the Drill sowing—were the factors responsible for this result, future experiments were therefore directed, both for the verification of previous results, as well as, for isolating the influence which each one of these factors exercised on crop growth.

The following table gives the results of 4 years trials with the Drill and the Nai :—

Table No. 1 showing outturns of wheat in lbs. per acre with the Drill and the Nai.

	1914-15.	1916-17	1917-18.	1918-19.
Drill	529	630	718	744
Nai	454	583	687	710

From the above figures it will be seen that the Drill gave higher yields throughout the experiments It was however not till 1918, that the drill underwent its crucial test, and brought enough conviction to adopt it for common use. The year 1918 happened to be the driest with little rain in September and October ; but in spite of this the Drill maintained its superiority in giving higher yields than those obtained with the Nai.

During the course of these trials, attention had also been directed towards observing the various characteristics of Drill sowing, and the principles they involved. As a result of these observations "Shallow sowing" and "Wider sowing"—the two main characteristics of the Drill were seen to produce the effects which are summarised as below.

Shallow sowing.

1. *Economy in time or saving in cost.*—The Drill coulters which are adjusted to sow only three to three and half inches deep as against 5 to 5½ inches deep as in case of Nai—require less draught, making possible thereby the use of an additional coulter without increased demand for power. This evidently results in either 50 p.c. saving in time or cost.

2. *Saving in seed.*—Deep sowing results in taking out clods which while overlying the furrows choke up the young seedlings coming out from below. Germination is therefore adversely affected when the sowing is deep and close. With equal seed rates, the p.c. of germination was 74 and 55 for the Drill and the Nai respectively. Assuming that the measure of stand in the 15″ Nai plot is the "Standard" the seed rate with 15″ drill should be less by 18 lb. to the acre.

3. *Increased yield.*—This is due to the fact that the feeding area of such a crop is increased by a layer of about 2″ which intervenes the seeding depths of the two types of sowings under question. Naturally the shallow sown crop gives higher yields under same conditions.

Wider planting.

1. *Saving in time or cost.*—This is obviously due to increased space covered per turn. This means a saving of 20 p c. in time with the Drill.

2. *Saving in seed*—For securing 'standard' stand of wheat, 18′ drill would require a seed rate of 42 lb. per acre against 52 lb. required by 15″ drill.

3. *Increased yield.*—The results in this respect are as set out in the following table:—

Table No. 2 showing outturns of wheat in lbs. per acre with 15″ and 18″ distances between the rows.

	1916–17.	1917–18.	1918–19.
18″ Distance	783	768	750
15″ do.	630	718	744

The above figures have varied much; and the yields of 1918-19 particularly are almost at par with each other; but the chief reason of this lack of sufficient difference in favour of 18″ planting appears to lie in the fact that a seed rate of 70 lb. was used in both the 15″ and 18″ plots. This caused a greater concentration of seed in the latter which the low moisture content of the year could not possibly support. This view was further strengthened by the results of a 50 lb. set of the same year. The relative increased yields obtained with different seedrates is as given below.

Seedrate.	p.c. of increase of 18″ over 15″ planting.
70 lb.	7%
50	19%

This tended to show that for obtaining success with 18″ planting, what is required, is only a careful adjustment of seedrate, and this done there is absolutely no harm in adopting 18″ planting for common practice.

The result of a proper depth and distance for wheat sowing has been combined in 18″ drill, which may be said to possess the following advantages over the local method of 15″ deep sowing as affected by the Nai. The advantages as calculated in money value are as under :—

	Per acre. Rs.	As.	p.
(1) saving in time 50%	0	11	3
(2) saving in seed 28 lb. per acre	2	0	0
(3) Increased yield at about 40 lb. per acre	2	0	0
Total Rs.	4	11	3

The principle of shallow sowing as brought out in the paper is also applicable for the sowing of gram and linseed, which are the other rabi crops of Central India.

With the adoption of 18″ drill for wheat sowing, it is hoped that the sowings will be Quicker, Cheaper, Timely, and Productive of larger yields than is possible with the Nai.

Section of Mathematics and Physics.

President :—T. P. BHASKARA SHASTRI, Esq., M.A., F.R.A.S.

Presidential Address.

SOME RECENT ADVANCES IN OUR KNOWLEDGE OF THE STRUCTURE OF THE UNIVERSE.

Before opening our proceedings to-day, let me thank the authorities of the Indian Science Congress for the honour they have conferred upon me by inviting me to preside in this section. I felt some hesitation in accepting this responsible office. for, on the various subjects which generally come within the domain of this section, I can scarcely hope to speak with any claim to authority. So far as I think, there can be only one reason for my being called upon to take this chair, that is I should discharge a part of the high duties connected with this office by addressing you on a few of the problems regarding the great Universe of stars, which are engaging attention in our modern observatories.

2. In 1920, at the Nagpur meeting, the President in this Section, gave an address which among other topics of interest dealt with the great geophysical problems, Seismology and Terrestrial Magnetism. Last year at Calcutta, we listened to an illuminating exposition from this chair about the object and methods of upper air research which showed what a profitable field for investigation lies within a short distance above our heads. To-day, let me take you to those remote regions of mystery which sketch far beyond the limits of the Solar system in which the Sun, with his retinue of planets and their attendant Satellites, forms but one of several million units. It is my purpose to speak about some of the recent advances that

have been made in our knowledge of Stellar Distribution and the Structure of the Universe. I realise the difficulties of attempting, in the limits of this short address, anything like a comprehensive survey of the problem and shall therefore content myself with referring briefly to certain of its important features, illustrating the methods of present day astronomical research.

3. The subject has attracted the attention of astronomers from the earliest times; yet it is only within the last few years, perhaps two or three decades, that systematic research in this branch of astronomy has become possible and several new facts concerning the heavens have been discovered. Sir William Herschel was the first to recognise that the chief aim of Astronomy is to obtain a knowledge of the Construction of the Heavens. For this purpose, he set himself the task of making powerful telescopes and explored the heavens with assiduous skill and energy; his observations were, of necessity, confined to a general survey of the numbers of stars and their apparent distribution in the sky. He discussed his observations with keen critical insight and obtained results sensibly accordant with those obtained by modern methods

4. Herschel's pioneer work considerably influenced the progress of astronomy during the whole of the last century. Though by itself, more than ordinarily rich in important discoveries, that century may justly be regarded as a period of preparation for the remarkable developments thus far achieved in the present century.

There are certain characteristic differences between the older field of astronomical research and the modern. In the older period, the addition to our knowledge was generally of an isolated fact like the discovery of a planet or an asteroid, of an additional Satellite to Jupiter or Saturn or of some peculiarity of a star such as its being a double or a variable The modern period has, by the resources of the methods employed, produced an overwhelmingly large number of individual discoveries and has thus led to the deduction of wide generalisations regarding classes of objects. It is recognised that the fact of a certain star being a double or a variable adds very little to our knowledge except in this that by the accumulation of similar discoveries, the peculiarities of classes of objects can be studied in relation to the larger problems of astronomy.

5. Progress in the branch of astronomy we are considering, seems to have proceeded slowly for a time on account of the want of sufficient data. Recently, however, by the gradual perfection of instrumental methods and appliances an enormous increase in the observational material has become available to investigators so that rapid development has become possible.

6. Two principal features of modern astronomical observa-

tions have contributed largely towards a successful attack on the problem of the Structure of the Universe. These are—

(1) The general introduction of photographic methods consequent to the invention of the "dry plate."

and (2) The application of the spectroscope to the study of the heavenly bodies.

7. The immense power of the photographic method rests on some of its essential properties. First, the impressions can be accumulated—a fact of considerable importance when faint objects are concerned. The photographic plate enables us to store up the feeble light impressions received through the telescope, so that even a small instrument, in these days of dry plate, acquires "a new dimension" and can, in some respects, produce results quite as efficiently as a large one.

The second important factor is that by the photographic method large regions of the heavens can be recorded at the same exposure. Prof. Barnard, Max Wolf and others, have thus studied the structural peculiarities of the Milky Way and other special regions which could never have been revealed by the visual method.

The accuracy and the facility in manipulation have all added to the importance of this new method. In fact it has enabled progress to be achieved by leaps and bounds especially in directions where only slow headway could be made before.

8. Great as are the advantages derived by astronomy from photographic methods, the wonders revealed by the spectroscope have far surpassed the most liberal expectations Prior to its introduction, the ray of light gave us very little information beyond the precise direction of the star, and its brightness. The same ray of light when passed through the prisms of a spectroscope forms an indispensable source of information regarding its temperature, physical condition and chemical constitution. By the observation of the lines in the Spectra of stars we learn besides, how the stars may be classified, how fast they are moving and in several cases how intrinsically bright they are. I shall deal with these points later on in this address. The spectroscope in the Slitless form (the objective Prism) has enabled Prof. Pickering and his colleagues at Harvard to classify thousands of stars according to their spectra. The Harvard system of classification based on Draper's earlier researches has now transplanted Father Secchi's divisions into Types and is now generally adopted by all investigators. The main classes in the Harvard system are designated by the capital letters O B A F G K M R N while there are a number of sub-classes occupying intermediate positions in this scale.

The sequence is in order of temperature, the O and B stars being the hottest. The designations are not in the same order as that of the alphabet, on account of the readjustment in our ideas owing to accumulation of new facts and the revision which consequently becomes necessary.

The Henry Draper Catalogue, now in course of publication at Harvard gives in detail the classified spectral type of about 222 000 stars in all parts of the sky and forms a mine of information on the subject for all investigations.

9. It will be apparent from what has been said how enormously the work of our astronomical observatories has outgrown, since the introduction of these various methods. Many of the problems require years of continual observation which is surely beyond the means of a single observatory. But, happily, well-planned co-operative methods of attack have proved invaluably useful. It is impossible to over-estimate the influence of co-operation in astronomical research by means of which results of far-reaching importance are fast accumulating. An undertaking of this kind inaugurated in Paris in 1887 had for its object the systematic mapping of the positions of a large number of faint stars, thus extending the great work of Argelander and Schonfeld to stars of much fainter magnitudes. Eighteen observatories (one of which is the Nizamiah Observatory at Hyderabad) have joined in the undertaking and are producing by photographic methods, catalogues which will ultimately give the accurate positions and magnitudes of about 5 million stars down to the 12th magnitude. The work is now fairly advanced and some important information has already been obtained. But even more valuable results are expected when the survey is completed and the vast amount of material properly discussed.

10. An essentially similar undertaking carried on by co-operation is the "Plan of Selected Areas" On account of their vast number, Prof. Kapteyn realised that it would be extremely difficult, if not impossible, to obtain for the whole sky all the necessary information about the faintest stars below the 11th or 12th mag. In 1906, he suggested that, for a preliminary study of the problems of the Universe, at least certain special representative portions of the sky should be studied in great detail. He accordingly selected 206 areas uniformly spread over the whole sky, which were supplemented by 45 special areas in the Milky Way and these areas are at present assiduously studied from several standpoints in a number of European and American Observatories, each institution following a line of research suitable to its instrumental equipment and geographical position.

Form of the System.

Considerable information regarding the broad features of the Universe can be gained from a study of the brightness of stars.

In recent years much attention has been given to stellar photometry as a profitable field for investigation which has resulted in the accurate determination of the magnitudes of a large number of stars. The late Prof. Pickering has published from Harvard two great catalogues giving the visual magnitudes of all, brighter than 6·5 on a uniform scale. At Potsdam Müller and Kempf have completed a determination of the photometric magnitudes of a large number of stars in the Northern hemisphere brighter than 7·5.

Since the introduction of photography the sensitive film has been employed for measuring the light intensities of stars thus providing a system of magnitudes directly unrelated to the eye. The ordinary photographic plate is restricted in its sensibility to light in the blue and the violet; and measures, for ordinary exposures, the intensity of star's light in these regions. Extensive researches have been made at the Harvard Observatory for calibrating the scale of these magnitudes The Harvard North Polar Sequence furnishes accurate determinations of the photographic magnitudes of stars round the North Pole, ranging from the brightest by continuous gradations down to the stars of the 21st mag. indicated by a light ratio of one to one hundred millionth. The sequence serves as an excellent standard for comparing the magnitudes of stars in other regions. Similar investigations have also been made at a number of other observatories notably at Göttingen, Mount Wilson and Yerkes for securing a uniform scale of photographic magnitudes. The difference between the photometric and the photographic magnitude is termed the colour Index; it is related to the star's spectral type and forms and excellent measure of its colour.

Counts of stars up to definite limits of magnitude give much information about the extent of the stellar system. Systematic counts have been made in the vast amount of material available from the photometry Catalogues, the Bonner Durchmusterung, the astrographic catalogues and charts, from the Franklin Adam's chart plates and the Durchmusterung plates of Kapteyn's selected areas. An examination of the results shows that the star-ratio (i.e. the ratio of the number of stars to any magnitude to the number one magnitude brighter) falls below the theoretical value derived on the assumption of a uniform distribution in all parts of space. It is steadily decreasing from about 3·7 for the brighter stars down to 1·6 for the faintest of about the 20th mag., thus indicating that there can be, few, if any, stars below the 28th or 30th magnitude and that our galactic system to which our counts refer is, after all limited in extent.

Another important feature connected with the apparent distribution of stars is known as the Galactic concentration, i.e. the increase in star-density per unit area of the sky with decreasing distance from the Galactic plane. Stars of all degrees of brightness are more numerous in the vicinity of the Milky Way which is thus of fundamental importance in all stellar problems. The crowding towards the galactic plane is however found to be most pronounced for the faintest stars. The results of various researches in this connection by Kapteyn, van Rhijn, Seares, and Chapmen and Melotte give values for the galactic concentration in substantial agreement with one another.

Forming the star ratios for the several galactic belts, it is found that though their decrease is an essential characteristic for all parts of the sky, the regions most affected are near the galactic poles where the ratios are uniformly smaller. The system seems to be thinning out in all directions but most rapidly towards the poles of the Milky Way. The great bulk of stars whose counts are available, apparently from a highly flattened spheroid, somewhat like a lens, whose greatest extension lies in the direction of the Galactic plane. Newcomb, from independent evidence has found that a sphere of radius 3300 light years will include essentially all stars in the direction of the Galactic poles.

A scattering or absorption of light in its passage through interstellar space will, if it exists, strongly affect these conclusions regarding the form of the galactic system. Seares and Hervprung have found from the colour indices of extremely faint stars that they are on the average redder and deficient in blue and violet light. This may be due to a small selective absorption in space where effect would be to cut off light of these wave lengths. But Shapley's researches on the colours of stars in clusters have proved beyond doubt that such absorption should be inappreciably small. These clusters which are known to be about 30·000 parsecs distant from the Sun contain stars of all colours from the bluest to the reddest. The range in index is the same as that for stars near our system which cannot happen if there is any sensible absorption of light in space. But, this does not preclude the existence of some small local obscuration in special regions of the sky which Turner has detected from the counts of stars of different magnitudes made on the plates of the "Carte du Ciel" he considers the maximum obscuration to have a spiral form whose equation may be expressed as $\alpha + 3{\cdot}668 = 247°$.

Particular areas, as the dark patches in Taurus, the great rift near θ Ophiuchii have been carefully studied by Barnard and others, which tend to show that the vacant spaces are due to some kind of local absorption caused by the existence of opaque material, perhaps invisible nebulae, at a comparatively short distance, screening whatever lies behind them — though in some cases, a real paucity of stars has been offered as an explanation from other considerations. The recent researches of Kapteyn on the average mass of stars [1] seem however to indicate that there can be no great amount of such dark matter in the Stellar system.

Stellar Distances.

For an investigation of the arrangement of stars in space a knowledge of their distances is indispensable. The problem presents exceptional difficulties as the displacement in direction when viewed from the opposite ends of a diameter of the earth's orbit, is so minute even for the nearest stars Sir David Gill once compared the problem to that of measuring "the angular diameter of a threepenny bit two miles away." It is no wonder that very little progress could be made at first in this direction.

The parallax of 61 cygni was first measured in 1838 by Bessel at the Konigsberg Observatory. This was soon followed by the parallax measures for two other stars made by Henderson and Struve. Since then with every instrumental advancement, the number has been gradually increasing. By the year 1880 the distances of about 20 stars had been successfully measured. The heliometer which was originally devised by Bessel and brought to perfection in the closing years of the last century has been employed with great success by Sir David Gill, and Prof. Elkin of the Yale Observatory. By their labours, the distances of about one hundred stars have been carefully determined. More recently, photography, especially with long focus instruments has yielded much valuable result and nearly 800 well determined parallaxes are now available to the investigator.

An entirely different method for inferring the distances of stars based on a new physical principle has been developed by Adams and Kohlschutter from the Mount Wilson Observatory Adams discovered a remarkable relationship between the absolute brightness of a star and the relative intensity of certain pairs of lines in its spectrum. He found it possible from this relationship to determine directly the luminosity of a star from an inspection of its spectrum, at least for all but the bluest types. The apparent magnitude of a star depends only on two factors its intrinsic luminosity and distance, so that when the luminosity is known, the distance can be inferred by means of a simple formula.[2] This method requires far less labour than the trigonometrical method and Adams has been able to measure the luminosity of hundreds of stars this way, a recent list containing as many as 1600 entries.

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[1] British Association, Edinburgh, meeting 1921.

[2] $M = m + 5 + 5 \log \pi$

A detailed study of the stars nearest to our system brings several interesting points to light regarding the arrangement of stars in space. We shall first consider that portion of the Universe which is in the immediate neighbourhood within a distance of about 5 parsecs. Among the stars within this sphere, there are only four of the first magnitude. Sirius, Procyon, Centauri and L. Aquilae, while the majority of the rest seem to be only small fry, the faintest stars being the Barnard Proper motion star in Ophiuchi mag. 9·7, the star of large P.M. in centaurus discovered by Prof. Innes mag. 11·0. It is very probable that we know all stars within this sphere whose luminosity is greater than one hundredth part of that of the Sun.

Prof. Eddington has made a comprehensive research about these stars and deduced some important results. The luminosities of the stars exhibit a very great range. Sirius the most luminous in the neighbourhood radiates about 48 times as much light as the Sun, while the tiny Innes star—the faintest star yet known, only one ten thousandth part. When stars in other parts of space are also considered, the range in luminosity is found to be even much greater.

For those binary stars with well observed orbits, the masses can be determined whenever their parallaxes are measurable. The few systems thus far studied, show that the masses of stars have no large range, similar that in their luminosities, and are generally not far from the mass of the Sun. The Sun seems to be an average star, one-third of the number of stars known to us in this corner of space, are more luminous while two-thirds are less luminous than the Sun. Further the luminosity decreases with spectral type—from the blue stars down to the red—the stars of late type of spectrum being all dwarfs

One other feature may also be noticed; the stars that are intrinsically brighter move on the average more slowly than stars less luminous and a change of nearly 6·8 Km. per second in the transverse velocity per unit of absolute magnitude is deduced by Prof. Eddington within a radius of 5 parsecs. Adams has also found a great mean radial velocity for the faint stars in the neighbourhood of the Sun. We shall have occasion to return to this point later.

The Motions of Stars.

Next to direct measures of Stellar distances, the most valuable data are furnished by their motions, of which our knowledge may be considered to be at present more extensive. The movements of stars are readily resolved into two components, one in the line of sight and the other in the transverse direction—the two being found by different methods.

The transverse component, known as proper motion is determined solely by the comparison of the positions of a star at different epochs. Accurate observations of the positions of the brighter stars began with Bradley in 1755 and since his time a large number of faint stars have been added in the various star-catalogues of precision. As the time-intervals between the catalogues increase, the proper motions of a larger number of stars are found with accuracy. The bright stars have been fully treated by Boss whose Preliminary General Catalogue stands as an unrivalled source of information, giving the accurate Proper Motions of more than 6000 stars.

By the labours of Auwers and of Kapteyn the early observations of Bradley have been carefully re-reduced, with the result that several reliable proper motions have been determined. For the motions of faint stars, the chief sources of information are the discussions by the present Astronomer Royal, of the Groombridge and the Carrington stars, and the comparisons of the "Carte du Ciel" photographs taken at different epochs in the Greenwich, Oxford and Helsingfors Zones.

The motion of a star in the line of sight is determined by measuring the Doppler Fizeau Shift of the spectral lines with a spectroscope. The early attempts made by visual methods were generally unsuccessful, though Keeler with the great Lick telescope had measured the radial velocities of a few stars and some planetary Nebulae. The first reliable measures of radial velocities were obtained in 1890 by Vogel and Scheiner of Potsdam by photographic methods. The subject has, since been taken up at a number of observatories, the most important contributions coming from the Lick Observatory organisations, where the radial velocities of more than 1200 of the brighter stars have been determined. Prof. Campbell and his Colleague Wright have made vast improvements in the designs of spectrographs by which a considerable gain in accuracy has been effected; the speeds of stars with sharp spectral lines are now being measured with a probable error of only $\frac{1}{4}$ Km. per second; a systematic error depending on spectral type has however been discovered by Campbell, the largest amounting in the case of B type stars to about 5 Km. per second, probably due to pressure effect in the extensive atmospheres of such stars. The radial velocities of a considerable number of faint stars have been observed at Mount Wilson, and the Royal Observatory at the Cape has also published some excellent measures.

A consideration of the proper motions of a few stars did not fail to convince Herschel that a part of the motions must be attributed to the motion of the Sun through space. By a simple graphical process he deduced the direction of the Solar motion from the proper motions of only 13 stars all that were available in his time. Herschel's position of the Solar apex R.A. = 262°, D = 26° is in sensible accord with modern determinations.

As more proper motions became known, the problem began to engage increasing attention. Two different methods have been developed by Airy and Bessel for determining the direction of the Solar motion assuming the random nature of the proper motions of the individual stars. A large number of investigations based on these methods have been made which have resulted in somewhat widely different values for the position of the apex. The R.A. in all these determinations remained very nearly the same while there was a wide range in the values for the declination which seemed to depend on the magnitudes of the stars employed. Recently Weersma of Groningen has found the position of the apex by a method originally due to Bravais, which does not proceed on the random character of all stellar motions, but involves some assumptions regarding the masses. His result was $A = 17^h 51^m$, $D = 31°{\cdot}4$ which may be taken as the best determination we have at present

Kapteyn has examined in detail whether the different parts of the stellar system are relatively at rest. He finds that the velocity of the Sun is approximately independent of the system of stars whose proper motions are discussed in the solution. Weersma has shown how the position of the apex remains unchanged when stars of different galactic latitudes are considered. It is true there are discordances in the declinations of the apex according to the magnitudes of the reference stars, but Kapteyn holds that these discordances are in the main, spurious, probably due to small systematic errors in the catalogue declinations depending on the brightness of the stars—errors which are known beyond doubt to exist. Proper motions being a much better criterion of stellar distances than magnitudes, he has shown conclusively that the declination of the apex does not depend on the distances of the reference stars.

An entirely different value for the coordinates of the Solar apex was obtained by Kobold by following Bessel's method. It was found difficult to reconcile the positions obtained by these different methods until Kobold himself pointed out that "the results could be harmonised on the assumption that the *motus peculiares* of stars take place in the plane of the Milky Way, some in the direct sense and others in the retrograde sense" This cautious statement was later fully confirmed by the brilliant discovery of Kapteyn that the stars show decided preferences for motion in two diametrically opposite directions. If the stars are assumed to be moving at random and the Sun fixed in space, the observed proper motions will be equally numerous in all directions, so that the velocity diagram will be a circle. If the Sun also is considered moving, the velocity diagrams will change into ovals, the elongation of the oval will depend upon the magnitude and direction of the Solar motion. By a graphical method Kapteyn analysed all the available proper motions grouping them for small compact areas in the sky, and found that the velocity curves were not simple ovals but pear-shaped figures which showed that the proper motions had a preference for two directions; when these prevailing directions for the different areas were compared, it was clear that they fall into two groups, the directions of each group converging to a point called the preferential vertex

Kapteyn announced in 1905 that the phenomena are satisfactorily explained by supposing that the great majority of stars whose proper motions are known, belong to one or the other of two great interpenetrating swarms whose motions relative to the Solar system make an angle of 100° with each other. The speeds are as 1·52 to 0·8 and the numbers of stars in the two systems are as 3 to 2. Further the motion of one swarm relatively to the other is found to be exactly parallel to the plane of the Milky Way. Kapteyn has given the name star-streaming or star drift to this tendency of star to move in certain favoured directions. From a study of 1900 stars whose proper motions are greater than 20″ per century, Dyson has substantially confirmed Kapteyn's conclusions. He has also found a value for the separation-speed of the two drifts – 2·6 times the velocity of the Sun, i e. about 48 Km. per second

Schwarzchild has developed another method of representing these peculiar motions which is called the Ellipsoidal hypothesis. In this theory, unlike Kapteyn's, the stars are all considered to belong to one system and if the components of their real motions are on the average great in one direction than in any other, these motions may be represented graphically by all the radii of an ellipsoid whose longest axis coincides with the direction of preferential motion in Kapteyn's theory. This representation by Schwarzchild is found more suitable for discussing motions in the line of sight. It can readily be seen that the principle underlying the two representations is practically the same—a greater mobility of stars in two opposite directions—and both serve as a good first approximation giving the same results over the limited period of time we can deal with.

A closer approximation than the two drift theory was discovered by Halm who pointed out that a certain number of stars form a separate third drift (called by him Drift O) without seeming to participating in the two great drifts of Kapteyn. Their apparent motion is directed towards the Solar antapex and thus all stars of this drift would be at rest in space if the effect of Solar motion were eliminated. The early B-type (Orion) stars on account of their small peculiar motions appear to belong exclusively to this drift.

Prof. Turner has made an interesting suggestion which seems to offer a reasonable explanation of these phenomena. He showed that the convergence of the preferential motions need not be interpreted as due to the motions being in parallel directions in space, but may be due to an actual convergence of their real directions. If the stars are assumed to move in very elongated orbits under the general attraction of the stellar system, the motions will be preferentially radial and will fall into two groups one moving to the centre and the other receding from it. From this point of view, it is easy to find an explanation for the drift O-phenomenon as exhibited by that group of stars situated at the apsidal positions of these elongated orbits.

Recently, by applying some results of the kinetic theory of gases, Kapteyn has derived values for the average mass of stars at different distances and thence has attempted on dynamical principles, to give an explanation for the phenomena of the star-streams. He finds for the average linear velocity a value of 19·5 Km. per second for all distances greater than 200 parsecs, which gives a relative velocity of about 39 Km. per second for the two streams—a result agreeing fairly well with the velocity actually observed.

The theory of star drifts has received substantial confirmation from motions in the line of sight. Several determinations of the Solar motion have been made from the material furnished by the radial velocities and the results are in fair agreement with those obtained from Proper Motions As the radial velocities are determined directly in linear measure, the speed of the Sun can be deduced with a high degree of accuracy. Campbell has found a value of 19·5 Km. per second for the velocity of the Solar motion. A recent determination by Forbes from a large number of observations. gives a speed of 22·73 Km. per second. The Sun's velocity forms one of the fundamental constants in stellar investigations, as the motion of the Solar system provides a much longer base line than any other available to the terrestrial observer.

Moving Clusters.

Passing on from these systematic motions we shall consider those local aggregations of stars widely separated from each other and yet possessing the same common motion like a flock of birds in migration. They appear to be definite systems, the members of which are physically connected with each other and have several characteristics in common. The first example of such a moving cluster was discovered by Prof. Boss during the course of his work on the great Preliminary General Catalogue. He found that in the region Taurus, there are a number of stars whose proper motions seem to converge to a point The equality and convergence of these proper motions show that the stars must be moving with equal angular velocities in parallel directions. The spectroscopic determination of the radial velocities of a few of the bright stars gave conclusive evidence that the members of the system possess the same linear speed. In the case of such moving clusters, the distances are by an indirect method determined with accuracy when the point of convergence found, and a complete knowledge of the positions and luminosities of the individual stars can be easily obtained.

Another remarkable cluster is the Ursa Major group which was first investigated by Ludendorff. This seems to be a highly flattened cluster and includes a number of other stars scattered over a great part of the sky. Herzprung has shown that the star Sirius belongs to the same association. The lateral extent of the cluster is about 50 parsees while the thickness may be only about 8 parsees. The velocity is 29 Km. per second towards R.A 285° Dec. – 2°.

Several clusters of a similar character have been detected during recent years; chief among these are the Perseus cluster. the Scorpio—great cluster in the Scorpio—Centaurus region, the 61 Cygni group and the B-type stars in Orion. The motions and other peculiarities of these groups have been thoroughly investigated by Kapteyn, Boss and Eddington. A less important cluster has been recently added by Axel Corlin Streaming towards β. Monocerotis.

Prof. Eddington has drawn attention to the important fact that the chance attractions of stars in the neighbourhood of these clusters seem to have no effect on the motions of the individuals and that the clusters preserve their motion in spite of the occasional disturbance from interlopers (non-cluster stars) in the region they happen to traverse. It is difficult to avoid the conclusion that the stars should be moving under the total attraction of the whole mass of stars and not under the sway of any particular individual or group. As Miss Clerke has said "these systems may be described as autonomous democracies."

A knowledge of Stellar motions is very useful in giving us an estimate of the distances of certain groups of stars which show at least partly, the scale in which the stellar system has been constructed. The proper motions has furnished much valuable information in this direction. The component of a star's proper motion in the direction of the Solar motion is due partly to the real motion of the star and partly to what is termed the parallactic drift, i.e. to the effect of the observer's motion through space. The mean parallactic drift of a group of stars, may, on the assumption of random character of the motion of individual stars, be taken as exclusively due to the motion of translation of the Solar System. As the latter is known accurately in amount and direction, the mean parallactic drift gives at once the distance of the group. The Astronomer Royal has investigated the proper motions of the Groombride and the Carrington Stars and has obtained an expression for the mean Secular parallax of stars of different magnitudes in the region. Kapteyn has in this way made an extensive study of the distance of the B-type stars which are known to have very small individual motions and of groups of stars possessing other peculiarities in common.

The radial velocities, when treated in intimate association with proper motions, enable us to make independent estimates of distances of groups of stars. From the doctrine of chances, are deduced the relations between the average speed in space, the average radial velocity and the average of all the transverse components. Thus when the average radial velocity of a group, cleared of the effect of the Solar motion, has been found, it is easy to calculate in linear measure, the average of all transverse components. The latter being already known in angular measure from the available proper motions, we have an indirect but effective method for inferring the distance of the group.

In a comprehensive study of the various problems connected with the Stellar system it is found necessary to consider how the several observed facts are connected with the star's spectral type. In the words of Prof. Kapteyn [1] " the mixing up of all the spectral classes must singularly diminish the effectiveness of any statistical treatment. It is as if we investigated statistically the size of all the members of the animal kingdom from the biggest to the smallest. It must be evident how much more effective must be the treatment of smaller groups such as the genera or the species."

A statistical study of the counts of stars according to their spectra reveals some interesting facts. The stars of different spectral types are not uniformly distributed in the sky. The B-stars, as far as can be made out from the star-ratios, are found to be thinning out very rapidly; they appear to belong exclusively to a local cluster in the neighbourhood of the Sun, whose equatorial plane is inclined at an angle of about ten degrees to that of the general galactic system. Among stars brighter than 6·5 the rapid increase in the number of the A, F, stars with decreasing brightness is another important feature which shows that stars of these types occur in larger numbers beyond a certain distance from our system. The Milky Way seems to be composed largely of class A-stars.

Regarding the distribution of fainter stars according to spectral type. our information is limited; but Shapley has pointed out that stars of the B-type are to be found even below the 9th or the 10th mag. but these should be real Milky Way objects.

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[1] Groningen Publications 29.

The B-type stars show a marked preference for the Milky Way which is exceeded only by those peculiar objects, the δ cepheii variables the N-stars, the stars of the Wolf-Rayet type and those with the c-characteristic all of which particularly congregate in the Galaxy. The stars of the other types do not exhibit such a preference to any high degree while the distribution of the M-stars is remarkably uniform without the least tendency for crowding near the Milky Way. From a consideration of the mean parallaxes of stars of different spectral types, it will be apparent, how for the distant stars the galactic condensation is a good Criterion of the mean distance. A remarkable relation between a star's peculiar motion and its class of spectrum was discovered by Campbell in 1910, from a study of the residual radial velocities of about a thousand stars. He pointed out that the average linear velocities increase with advancing spectral type a result which has also been confirmed by Boss from a discussion of transverse motions A reasonable explanation for such a progression has been offered by Russell from a study of the stellar masses according to spectral Type.

The relationship between the class of Spectrum and luminosity (absolute magnitude) has been investigated independently by Herzprung and Russell which has resulted in the important discovery of the existence of two series of stars which have been designated as Giants and Dwarfs. If the absolute magnitudes are arranged according to the type of Spectrum, it is found that in class B, the two series are coincident, but with advancing spectral type the gap between them widens, and in Type M, the stars fall into two distinct groups separated by a considerable interval. Adam's extensive determinations of absolute magnitudes amply confirm these significant facts.

The stars of type B form a fairly continuous group, the mean absolute magnitude being zero, indicating an average luminosity of about a hundred times that of the Sun. The division of the absolute magnitudes in two groups is perceptible for the spectral classes A and F, but it is not until type G is reached that the two series actually split. The difference between the mean absolute magnitudes of Giants and Dwarfs for type M is as much as 11 magnitudes corresponding to a ratio of 1 to 10,000 in their luminosities. It is also apparent that, if the two series are treated separately, the luminosities of stars of any spectral class fall within narrow limits.

The existence of the two series of " Giants " and " Dwarf " has upset all previous conceptions regarding stellar evolution in strict order of temperature. If Russell's views are correct, the life of a star begins as a giant in class M, by gradual contraction, it gets hotter, changing the spectral type sometimes even up to class B when cooling sets up carrying the star downward to the dwarf stage in class M. Eddington's famous researches on the life of a star from the theoretical side have provided substantial confirmation to this theory which has been deduced by Russell mainly from observational data. A significant relation is found to exist between the absolute magnitudes and the linear velocities of stars. Adams and Stromberg have found from an analysis of radial velocities that the speeds increase by 1·5 Km. per second per unit of absolute magnitude—a result which is much smaller than Eddington's estimate of 6·8 Km. from the transverse speeds of the nearest stars; the discordance is due, as Kapteyn has remarked, to the omission in the list of some stars with very small luminosity and proper motion.

Further, for the same absolute magnitude the K and M stars seem to have higher velocities than those of F and G types, the reason probably being that the linear speeds depend largely on stellar masses.

Star-clusters.

Passing on, from the individual stars and the galactic system, to the outer regions of space, we encounter some of the most difficult problems in sidereal astronomy. The methods of finding the distribution of the clusters in space are chiefly indirect, depending on the study of the apparent magnitudes and colour indices of the stars forming the cluster. Herzprung has shown how the distances of clusters can be deduced from the observations of the variables in these systems. He derives that·the absolute magnitudes of these variables should be the same as those of the cepheid variables in the galactic system and as the mean distances of the latter are known with tolerable accuracy, it is possible to find an estimate of the distance of the cluster. From the Harvard determinations of the magnitude of the variables in the Lesser Magellanic cloud, he concludes its distance to be about 10,000 parsecs. Recently Shapley has discovered some general properties of the globular lusters, which can, with some confidence, be used for estimations of their distances The relation between luminosity and some particular characteristic is first studied for stars in a known system and if the same characteristic is found to exist in a cluster, the luminosity may with some truth be assumed to be the same as in the comparison system which thus affords a clue to its distance. The variable stars, the absolute magnitudes of the 25 brightest stars, and even the simple angular diameter of the cluster have been adopted as criteria of the distance In this manner, the distances of a number of clusters have been estimated which have given us a true conception of the dimensions of these objects and the gigantic scale of the system to which these belong. The nearest cluster *w* Centauri is deduced to be 6500 parsecs distant, while there are clusters at more than ten times this distance. Our present state of knowledge with regard to these clusters, seems to indicate that they are in a way associated with the Galaxy and that the bounds of the Milky Way system are probably more extensive than were supposed some time ago.

Before concluding, I wish to take the opportunity of remarking how important are the theoretical investigations in the solution of these great problems of sidereal astronomy. A persistent attempt at the interpretation of the facts gathered forms one of the greatest necessities for the progress of a Science. Schwarzchild's elegant methods developed in his classical papers on stellar statistics have been of immense help in the analysis of the amazingly large amount of material supplied by present day observations. Eddington's theoretical researches on the internal constitution of stars have thrown much valuable light on the study of stellar evolution. In the many problems of stellar dynamics, Jeans and Eddington, have made important contributions from their investigations on the basis of the well-known laws of gravitation. Charlier has treated the problem of stellar motions by the methods of statistical mechanics in a manner analogous to the kinetic theory of gases. The theory of star-streams, the equilibrium of the galactic system, the dynamics of globular clusters, have all received attention during recent years. Developments in mathematical analysis and discoveries of new physical principles are constantly leading towards progress in these theoretical investigations. As Schwarzchild has once expressed it "Mathematics, Physics, Chemistry, Astronomy march in one front; whichever lags behind is drawn after. Whichever hastens ahead helps on the others. The closest solidarity exists between astronomy and the whole circle of exact Science. From this aspect I may count it well that my interest has never been limited to the things beyond the Moon, but has followed the threads which spin themselves from there to our sublunar knowledge ; I have often been untrue to the heavens. That is an impulse to the universal which was strengthened unwittingly by my teacher Seeliger and afterwards was further nourished by Felix Klein and the whole scientific circle at Göttingen. There the motto runs that Mathematics, Physics and Astronomy constitute one knowledge which, like the Greek culture, is only to be comprehended as a perfect whole."

In this brief address, it has been my endeavour to place before you how some of the facts regarding the structure of the stellar system have been recently added to our knowledge. By the gradual accumulation of observations, spread over long periods, a new field of enquiry has been brought under regular research which has enabled us to obtain a glimpse of the form and dimensions of the vast stellar universe. It must indeed be admitted, our information regarding several fundamental phases is still fragmentary and that our knowledge of the outlying portions of the system is yet somewhat speculative. But by the improved methods of attack at our disposal, the outlook appears to be quite hopeful.

A Statistical Study of some Examination Marks.—*By* P. V SESHU IYER *and* S. R. RANGANATHAN.

(1) Nature of the Frequence Curves.

(2) Fluctuations of the Mean and the Standard Deviation. Their effect on the minimum for a pass Disadvantages of a fixed minimum. Adjustment of the minimum.

(3) Probable Error in marking. Edgeworth's Analysis and results The margin of Probable Error in the neighbourhood of the minimum for each of the Intermediate subjects

(4) The fixing of the minimum. Its relation to the Mean and the Median.

(5) Correlation of the attainments of the candidates in various subjects. The best correlated subjects—Physics and Chemistry. The best correlated subjects—English and Mathematics. Fluctuations in the value of the correlation coefficients.

On a practice in Interpolation.—*By* K. B. MADHAVA.

Some considerations which indicate that generally, in an interpolation the best results will not be got by proceeding to the same order of differences throughout; but by studying the character of the differences, and stopping in each case at the point where they decrease to a minimum.

The effect of resistance on celestial motions —*By* K. B. MADHAVA.

It is sometimes held that the fall of meteors, the Zodiacal light, etc., suggest the possibility of some kind of resistance to the planetary and satellite motions. The secular variations of the elements are studied under this hypothesis; which suggests that, if the effect be appreciable in the motion of asteroids, which have small eccentricities in general, it must be remarkably great for the motion of the comets. But this is contrary to the known fact that the effect of resistance on the cometary motion is very small if it exists at all, and the question is raised why it should be so.

Behaviour of Metallic-filament Lamps.—*By* S. NARAYAN.

The paper discusses certain results obtained in the College of Engineering Physical Laboratory at Poona with others of a similar character found scattered in the minutes of Proceedings of the English Institution and the American Institute of Electrical Engineers. The variation of current, resistance and light under different circumstances has been considered and the practical aspect of the questions discussed pointed out.

Emission and absorption spectra of the halogens in the visible and ultra-violet regions.—*By* A. L. NARAYANA *and* D. GUNNAYYA.

The emission and absorption spectra of Chlorine, Bromine and Iodine, are studied by the photographic method. Emission Spectra were examined by Geyslar tubes, and other special discharge tubes about 25 cms. in length, furnished with two side tubulures, in which freshly prepared pure and well-dried silver salts were introduced to just cover the platinum electrodes sealed into these tubes, and the absorption cells used in the study of absorption were glass tubes of different lengths furnished with glass or quartz windows.

The experiments show :—

(*i*) That the emission spectrum is a line spectrum depending on the nature of discharge. As the intensity of discharge increased some lines are reinforced while others disappear.

(*ii*) The absorption spectra consists (1) of a banded spectrum in the yellowish-green region, and (2) of a principal absorption band in the ultraviolet, the width of this band depending on the pressure and thickness of the layer.

(*iii*) The principal absorption band shifts towards the less refrangible side, with the increase of Atomic Weight.

(*iv*) Beer's Law does not seem to hold good in the case of these vapours.

A modified form of double slit spectrophotometer.—*By* A. L. NARAYANA.

Being engaged in some spectrographic work on the absorption spectra of vapours and solutions in the visible and ultra-violet regions, the need for a good spectrophotometer is felt. And a modified form of double slit spectrophotometer is devised, which is free from the defects of Vierordts' photometer and which possesses many of the advantages of the sector photometer. It consists mainly of an electromagnetically maintained pendulum ($T=0{\cdot}5''$) the bob of which consists of two slits one above the other, whose widths can be adjusted by two micrometer screws. The slit widths are varied until equal illumination is obtained.

Movement in *n*-dimensions.—*By* R. VAIDYANATHASWAMI.

From the geometry of movement and from considerations of order in real spaces, the definition is reached of congruent transformations in non-Euclidean space with the Absolute Quadric $Ex^2 = 0$, as collineators represented by orthogonal transformations, viz. the reflections and the simple rotations are defined and discussed. The general regular congruent transformation is shown to split up into a number of permutable simple rotations. By considering the relation of a Euclidean movement with its component at infinity, the theorems obtained are shown to be true for Euclidean space also. The analysis is effected of the general quasi-regular Euclidean movement.

Thunderstorms in Trivandrum.—*By* K. R. RAMANATHAN.

Some results of an analysis of the thunderstorm record kept in the Trivandrum Observatory are given and a reason for the seasonal distribution of thunderstorms is suggested. Evidence is brought forward to show that thunderstorm activity is greatest when the gradient wind is least and there is maximum opportunity for the formation of strong ascending currents of humid air.

On upper air correlations.—*By* P. C. MAHALANOBIS.

In recent years Dines has developed a theory in which upper air changes are the dominating factors which determine the distribution of meteorological conditions on the surface of the earth. The arguments used are partly statistical in character, being based on the high observed values of the coefficient of correlation between the pressure at 9 kilometres above sea-level and various other elements. In the present paper it is shown that there exist *other heights* at which the pressures have got higher correlations. There is also true for partial coefficients. The position of 9 km. is thus not unique, and from the statistical point of view the peculiar importance of 9 km. is not sustained.

On the correction of a coefficient of correlation for observational errors.—*By* P. C. MAHALANOBIS.

Chapman (in a paper published in the Proc. Roy. Soc. 1920) has discussed the effect of correcting for observational errors. He has obtained very high values for the *corrected* upper air correlations, even reaching unity or absolute certainty in certain cases.

In the present paper it is shown that several grave statistical assumptions are involved in the above discussion and also that these statistical assumptions are not justified in the cases of the upper air data considered by Chapman.

On the probable error of the component frequency constants of a dissected frequency curve.—*By* P. C. MAHALANOBIS.

Part I. Symmetric dissection of the first type.—Pearson has given the solution for the dissection of a symmetric curve For platykurtic curves, the component means are different, while the standard deviation remains the same. In the present paper, probable errors of the component means are obtained and the results used for the determination of the reliability of dissection of the frequency distribution of heights of different Bengal Castes and Tribes.

Part II. Symmetric dissection of the second type.—For leptokurtic curves the standard deviations are different while the means are the same. Probable errors are found and applied to a numerical case of dissection of Anglo-Indian heights.

On the probable error of constants obtained by linear interpolation.—*By* P. C MAHALANOBIS.

In Physics linear interpolation is very commonly used for finding the "best" value of a constant. The straight line used for interpolation should of course, be the line of best fit, which is statistically the same as the principal axis of the correlation ellipse. In the present paper the probable error of a constant interpolated from the line of best fit is calculated in terms of the means, the standard deviations and the correlation of the two variables. Numerical examples will be given

An automatic "make and break" key for the heating and high potential circuits of a Cooledge X-ray tube.—*By* E. P. HARRISON *and* NARENDRANATH SEN.

On the experimental demonstration of the Temperature Radiation of Gases.—*By* M N. SAHA.

The author described an experiment which he had carried out at the Laboratory of Prof. W. Nernst of Berlin in 1921, for experimental demonstration of the temperature radiation of gases. The question was previously attacked by J. J. Thomson (Phil. Mag. 1905, Vol. 6, p. 583) and MacLennan (Proc. Roy. Soc. Lond., Vol. 93) but their results were indecisive. Thomson worked with sodium-vapour at 300°C and MacLennan with the vapours of *Hg, Cd, Zn* in a Bunsen flame. The author showed that the non-success of their experiments was due to the fact that the elements they had chosen possessed high ionisation potentials, and could not therefore be ionised to any appreciable extent at the temperatures used by them.

The author had previously given a theoretical treatment of the problem in several papers published in the Phil. Mag. 1920 and 1921, in which it was shown that the main factor in determining ionisation was the ionisation potential of elements, as deduced from the quantum law

$$\frac{eV}{300}=h \cdot v_0$$

where, e=electronic charge, h=Planck's constant, v_0 convergence frequency of the principal series of the element. The less was the ionisation-potential, the greater is the ease with which it can be ionised. The fraction x of atoms ionised under the pressure P, and temperature T is given by the Nernst-formula

$$\log \frac{x^2}{1-x^2} P=-\frac{U}{2.3RT}+\frac{5}{2}\log T-6{\cdot}5.$$

Where U is the heat of ionisation, and connected with V by the relation $U=\frac{eVN}{300J}$ where N=Avogadro number, J=mechanical equivalent of heat.

It is known that of all elements caesium has the lowest ionisation potential, (V=3, 83 volts), the next in order being *Rb*, and *K*. The author therefore tried the experiment with *Cs*. The heating vessel was a vertical platinum-tube furnace which could be heated to 1500°C by a current of 300-1000 Amp. from a low-tension transformer. The bottom was closed by pieces of burnt magnesia, and a current of hydrogen was allowed to flow through the furnace. A plantinum, plantinum-rhodium thermocouple was placed along the axis of the tube for measuring temperature A piece of *Cs*, *Rb*, or *K* was dropped from the top into the furnace. The metal vaporised, and displaced H_2. The furnace containing ionised caesium can be regarded as an electrolytic cell, with the platinum tube as one electrode, and the thermocouple as the other electrode. A potential of 1 to 6 volts was laid between the platinum tube and the thermocouple, with a calibrated milliamperemeter in series. The deflections of the milliamperemeter directly gave the resistance of the cell.

It was verified that with pure hydrogen or pure air, there is no trace of conductivity in the cell. But as soon as *Cs*, *Rb* or *K* was dropped into the furnace, a huge conductivity was obtained. With caesium, at 1250°C a current of 3 milliamperes was obtained under a potential difference of 1 volt. The specific resistance of the cell was found to be 50 ohms. The conductivity decreased with decreasing temperature, and was not detectable below 800°C. Under the same condition (1250°C) the resistances of *Rb*, and *K* vapour were found to be about twice and four-times that of *Cs* vapour.

The results are in accordance with the author's theory and are believed to be the first experimental demonstration that gases can be made conducting by heat alone.

Further Notes on newly designed Physical Apparatus.—*By* S. N. MAITRA.

This paper contains an account of a number of demonstration apparatus designed by the author. A previous communication was sent to the Science Congress held in Bombay.

The following have been added since :—

No. 1. Sliding Thermoscope for exploring temperature gradient along a bar heated at one end.

No. 2. Improved water model for heat conduction along a shewing radiation effect.
No. 3 Comparison of conductivities by "Null Method."
No. 4. Apparatus for shewing convection of hot air.
No. 5. Optical compendium.
No. 6. Mechanical Model for demonstrating Snell's Law.
No. 7. Apparatus for shewing apparent contraction of stretched India Rubber on heating.
No. 8. Apparatus for shewing adiabatic heating of rubber on sudden stretching.
No. 9. Apparatus for shewing equality of pressure at a point in a liquid.
No. 10. Commutators (2 Varieties).

The Pedal line family of a triangle.—*By* A. NARASINGA RAO.

In this paper the arrangement and the properties of the pedal lines of a triangle are deduced from certain fundamental characteristics of the linear aggregate they constitute, such as, the number through a given point, the multiple and the coalesced members of the system, etc. The condition for the concurrency, the equation in homogeneous coordinates and other results are thus obtained by a more natural and symmetric method than the one given in text-books. The problem of determining all triangles which have a common pedal line system is also touched upon.

Some recent researches at Kodaikanal.—*By* J. EVERSHED.

The Albedo of the Earth.—*By* C. V. RAMAN.

The Molecular Scattering of Light in Gases.—*By* K. R. RAMANATHAN.

Section of Chemistry.

President :—DR. N. R. DHAR, F.I.C.

Presidential Address.

INDUCED REACTIONS AND MECHANISM OF CHEMICAL CHANGE.

Definition.

If A and B chemically react with one another while A and C do not under ordinary conditions, but do so in the presence of the former reaction, the second reaction is said to be induced by the first, in other words, a chemical change between one set of substances is capable of forcing or inducing a chemical change between another set of substances having the potentiality to undergo a chemical change. For instance when an aqueous solution of mercuric chloride is boiled with oxalic acid, there is no reduction of the mercuric chloride to the mercurous state but as is well known this mixture of mercuric chloride and oxalic acid decomposes at the ordinary temperature in sunlight according to the equation :—

$$2HgCl_2 + H_2C_2O_4 = 2HgCl + 2HCl + 2CO_2$$

The same change, however, takes place in the dark (Dhar Jour. Chem. Soc. 1917, III, 690) if a few drops of a decinormal potassium permanganate are added to the mixture, as soon as the colour of the permanganate is discharged mercurous chloride begins to separate out.

This phenomenon appears to be of general occurrence.

Generality of induced reactions.

Thus it has been found out that the reduction of mercuric chloride and bromide by oxalic acid, tartaric acid, citric acid, malic acid, malonic acid, glycollic acid, cane sugar, grape sugar, glycerine, lactic acid. hydroxylamine, hydrochloride, hydrozinc-hydrochloride, etc., the reduction of gold chloride, by several reducing agents, and the reduction of silver nitrate, cupric chloride and selenious acid (to Selenium) by various organic acids are promoted by the addition of such oxidising agents as potassium permanganate, potassium persulphate, manganese dioxide, potassium nitrite hydrogen peroxide, ceric salts etc. (Dhar Proc. Akad. Vetensk. Amsterdam, 1921, 23, 1074).

10 It is a remarkable fact that this effect is particularly noticeable in those reactions, which are very sensitive to light.

According to the customary nomenclature, the faster reaction is called the primary reaction and that which appears to be forced along or induced by contact with the primary change is called the secondary reaction. The substance which takes part in both reactions is called the actor, the substance which takes part in the primary reaction is called the inductor, and the substance which takes part in the secondary reaction is called the acceptor. The way in which the inductor acts is not known and hence these induced reactions form a branch of catalysis.

Oxidation reactions.

Primary change.		Secondary change.	
Mercuric chloride	+ Sodium sulphite.	Mercuric chloride	+ Sodium arsenite.
,, ,,	+ Formic acid	,, ,,	+ ,,
,, ,,	+ Sodium phosphite.	,, ,,	+ ,,
,, ,,	+ Sodium sulphite.	,, ,,	+ Arsenicous acid.
,, ,,	+ Sodium phosphite.	,, ,,	+ ,,
Sodium sulphite	+ Air	Sodium nitrite	+ Air.
,, ,,	+ ,,	Potassium oxalate	+ ,,
,, ,,	+ ,,	Ferrous ammon sulphate.	+ ,,
,, ,,	+ Oxygen	Ferrous hydroxide.	+ Oxygen.

Oxidation reactions.

Primary change		Secondary change	
Sodium sulphite	+ Oxygen	Cobaltous hydroxide	+ Oxygen.
,, ,,	+ ,,	Nickelous hydroxide.	+ ,,
,, ,,	+ ,,	Cuprous oxide	+ ,,
Sulphurous acid	+ Air	Ferrous sulphate	+ Air.
,, ,,	+ ,,	Stannous chloride	+ ,,
Ferrous hydroxide	+ Oxygen	Nickelous hydroxide.	+ Oxygen.
Cobaltous hydroxide.	+ ,,	,, ,,	+ ,,
Manganous hydroxide.	+ ,,	,, ,,	+ ,,
Cerous hydroxide	+ ,,	,, ,,	+ ,,
Sodium sulphite	+ Air	Sodium arsenite	+ Air.
,, ,,	+ ,,	Manganous hydroxide.	+ ,,
,, ,,	+ ,,	Sodium thiosulphate.	+ ,,
Stannous chloride	+ ,,	Ferrous ammon sulphate.	+ ,,

In all the above mentioned cases at first the primary change, that is, the oxidation of the easily oxidisable substance takes place and this primary change induces or promotes the secondary or the induced change that is the oxidation of the difficultly oxidisable substance.

In several of these induced reactions we determined the induction factors. but unfortunately hardly any conclusion could be drawn from these induction factors as to the mechanism of these changes.

Oxidation has also been induced in the following substances in presence of sodium sulphite which was itself oxidised by passing oxygen gas through the mixtures.

Urea, starch, grape sugar, cane sugar, potassium oxalate, sodium acetate sodium potassium tartrate, sodium formate, sodium citrate, acetone, chloral hydrate, chloroform, glycerol, quinine sulphate, sodium succinate, methyl alcohol, ethyl alcohol, phenol, glutaric acid, maltose, potassium steerate, cholesterol, anthraquinone acetanilide, brucine, phenolphthalein and gum arabic.

The oxidation of ferrous hydroxide, freshly precipitated and carefully washed free from alkali, by passing oxygen through it in water induces the oxidation of the following substances:—

Urea, starch, grape sugar, cane sugar, potassium oxalate, sodium acetate, sodium potassium tartrate, sodium formate, sodium citrate, acetone, chloral hydrate, glucerol quinine sulphate, sodium benzoate, sodium succinate, methyl alcohol, ethyl alcohol phenol, phenolphthalein and gum arabic.

In the following cases of oxidation, either in presence of sodium sulphite or freshly precipitated ferrous hydroxide along with carbon dioxide, the presence of aldehyde (which is an intermediate product of oxidation) was detected by Schiff's reagent:—

Methyl alcohol, ethyl alcohol, amyl alcohol, glycerol glutaric acid, phenol and brucine.

In the case of oxidation of benzyl alcohol, acid test was obtained with litmus.

The wide application and the general usefulness of these induced reactions are evident from the fact that these various compounds which do not undergo oxidation by oxygen under ordinary conditions can be readily oxidised when they are mixed with sodium sulphite or ferrous hydroxide, which is itself being oxidised.

It is evident that there will be different stages of oxidation of these organic compounds until the final products of oxidation are obtained.

Relation to life processes.

It is impossible to ignore the importance of these reactions in their relation to the phenomena of oxidation and reduction in the animal body. It is well known that a molecule of stearic acid taken into the body in the form of fat undergoes combustion, so that eventually each of its eighteen carbon atoms will be converted into carbon dioxide but no one imagines that such a change is immediate or direct—that every carbon atom simultaneously parts with its attached hydrogen atoms and by combining with oxygen yields carbon dioxide and water We have brought about the same change in the laboratory with potassium stearate by inducing its oxidation by the primary oxidation of sodium sulphite or ferrous hydroxide by passing oxygen through the mixture at the ordinary temperature.

In the animal body, acetic acid is oxidised with great ease to carbondioxide and water. Its oxidation in the laboratory has been effected by us with the help of sodium-sulphite or ferrous hydroxide when it is being oxidised by passing oxygen through it.

The substance undergoing active metabolism in the animal body, comprising the proteins, carbohydrates, fats and their derivatives, are practically entirely resistant to oxidation by oxygen under ordinary conditions, yet in the animal body the carbon of all these of compounds is readily oxidised to carbon dioxide. It is generally conceded that some process of activation of the atmospheric oxygen must take place in the body in order to account for the observed chemical changes. It is remarkable that a very large number of such biochemical oxidations have been imitated in the laboratory by the simple process of induced oxidation as already mentioned. We are now engaged in further generalising this type of induced oxidation and in finding out the intermediate products of oxidation in these cases.

It has been shown in a previous paper that the oxidising power of hydrogen peroxide is greatly accelerated in presence of ferrous and ferric salts, thus if *tartaric acid* or starch and *hydrogen peroxide* be brought together at the ordinary temperature hardly any chemical reaction takes place, but as *soon as a ferrous or a ferric salt* is added the oxidation of tartaric acid or starch rapidly takes place (Dhar Jour. Chem. Soc. 1917, III, 694). There is a great importance of reactions of this type in the explanation of oxidations in the human body. The food in the animal body is oxidised by the atmospheric oxygen giving us heat and energy. In the animal body there is evidence with regard to the formation of a peroxide from the oxygen taken up by the animal and this peroxide oxidises the food taken up in the body.

Explanation of the use of iron salts in medicine.

As we have shown in the laboratory, that iron salts (either ferrous or ferric) markedly accelerate the oxidising power of the peroxide, similarly in the animal body the iron in haemoglobin present in the blood catalytically accelerates the oxidation of the food stuff by the peroxide formed in the body from the inhaled oxygen. Now when there is deficiency of iron in the blood, the animal body suffers from anaemia because the amount of catalyst necessary for rapid oxidation falls short. At this stage any iron salt taken in the system will supply the natural deficiency and the necessary amount of oxidation will take place. This is the probable mechanism of the internal use of iron salts whether ferrous or ferric in medicine. It has also been observed that induced oxidation can take place in the acetic fermentation of alcohol.

Negative Catalysis and induced reactions.

It is well known that a solution of sodium arsenite is not oxidised by atmospheric oxygen under ordinary conditions. On the other hand, a solution of sodium sulphite is readily oxidised to sodium sulphate.

Now if we mix the two together both the oxidations go on simultaneously. At the same time a curious phenomenon takes place. The velocity of the oxidation of sodium sulphite becomes very small in presence of sodium arsenite, that is sodium arsenite which is undergoing a slow oxidation acts as a powerful negative catalyst in the exidation of sodium sulphite. Similarly a solution of oxalate which also undergoes slow oxidation in presence of sodium sulphite, which is itself being oxidised, slows down to a marked extent the oxidation of sodium sulphite by atmospheric oxygen. Moreover we have observed that manganous hydroxide, ferrous hydroxide and sodium thiosulphate which are slowly oxidised by passing oxygen in presence of a solution of sodium sulphite markedly retard the oxidation of sodium sulphite. Also ferrous salts retard the oxidation of stannous salts in air. It appears probable therefore that the phenomenon of negative catalysis is possible only when the catalyst is liable to be oxidised. These cases are of great importance in connection with the controversial question of negative catalysis.

In a previous paper (Dhar Jour. Chem. Soc. 1917, III, 707) it has been shown that manganous salts act as powerful negative catalysts in the oxidation of formic and phosphorus acids by chromic acid and manganous salts easily pass into the manganic state. Moreover it has been shown by various investigators that some organic substances notably quinol, brucine, etc., act as negative catalysts in the oxidation of sodium sulphite by oxygen, all these organic substances are themselves readily oxidised. It is well known that the oxidation of phosphorus by oxygen of the air is retarded by the vapours of various organic substances, e g. ether, alcohol, turpentine, etc., and the oxidation of chloroform is retarded by the presence of a small quantity of alcohol. Now all these negative catalysts are good reducing agents, and are themselves readily oxidised. Hence in oxidation reactions the phenomenon of negative catalysis takes place when the catalyst itself is liable to be readily oxidised.

If we expose a mixture of sodium sulphite and sodium arsenite to atmospheric oxygen, according to Schonbein (Jour. Prakt. Chem. 75, 99, 1858) one atom of oxygen should go to oxidise one molecule of sodium sulphite while the other atom would oxidise a molecule of sodium arsenite in the same time. The oxidation of sodium arsenite is a very slow chemical change and in order that Schonbein's law be applicable it follows immediately that the oxidation of sodium sulphite which is fairly rapid, should become a slow change, and the velocity of this oxidation should become equal to that of the oxidation of sodium arsenite, because the same amount of oxygen will be taken up by the reducing agents in the same time. As a matter of fact from our experiments we have observed that in presence of sodium arsenite or potassium oxalate or manganous hydroxide or ferrous hydroxide the velocity of the oxidation of sodium sulphite by air becomes very small. We assume that a molecule of oxygen splits up in this reaction into two atoms and each atom oxidises one of the reducing agents. Now as a solution of sodium sulphite is much more readily oxidised than a solution of sodium arsenite it becomes difficult to understand why the other oxygen atom instead of attacking the readily oxidisable unacted sodium sulphite attacks the much more difficultly oxidisable sodium arsenite. Or, if we assume that at first a peroxide of the type of Bodlander's benzoyl peroxide (Ahrens Samm 3,470, 1899) is formed as a combination of the sodium sulphite with a molecule of oxygen we are still encountered with the same difficulty. In this case we shall have to assume that this peroxide instead of attacking the readily oxidisable unattacked sodium sulphite will attack the less readily oxidisable sodium arsenite by preference. It seems, therefore that the only course left to us is to find out the explanation in view of the formation of a complex of sulphite and arsenite or of sulphite and oxalate, and that this complex is oxidised as a whole. It is well known that complex oxalates and sulphites do exist.

Intermediate compound formation as an explanation of negative catalysis.

It has been observed in a previous paper (Dhar, Proc. Akad. Vetensk. Amsterdam, 23, 299, 1920) that in the oxidation of sulphite and sulphurous acid the sulphite ion is the active agent. On the addition of an arsenite to a sulphite, a complex which itself is oxidised as a whole is formed. At the same time the velocity of the oxidation of the sulphite becomes less due to the decrease in the concentration of the sulphite ions, arising out of the formation of a complex of sulphite and arsenite or oxalate. Hence it seems that the only plausible explanation of the negative catalysis stands on the hypothesis of the formation of an intermediate complex compound.

Induced precipitation.

The phenomenon of induced precipitation is of common occurrence When any one of the phosphates of iron, aluminium or chromium is precipitated by sodium phosphate in presence of acetic acid and calcium chloride the precipitate after being thoroughly washed with acetic acid gives test for calcium with ammonium oxalate.

Similarly strontium or barium phosphate is precipitated along with ferric phosphate or aluminium phosphate or chromium phosphate even in presence of acetic acid.

When any of the hydroxides of iron, aluminium or chromium is precipitated in an excess of concentrated ammonium hydroxide in presence of copper sulphate, zinc sulphate. nickel chloride or cadmium nitrate, the precipitates even after being thoroughly washed with concentrated ammonia give test for the ions in presence of which the precipitation has been carried out.

When calcium strontium or barium carbonate is precipitated by means of ammonium carbonate from any of their soluble salts containing a little of magnesium chloride, the precipitate after being thoroughly washed with ammonium chloride shows the presence of magnesium.

Moreover when a little of sulphuric acid is added to a solution of calcium or strontium or barium chloride containing ferric or chromium or aluminium salt the precipitated sulphates of calcium, strontium or barium contain iron or aluminium or chromium. Similarly lead sulphate is precipitated along with barium sulphate even in presence of a large excess of ammonium acetate.

Magnesium oxalate is precipitated with barium or strontium or calcium oxalate in presence of an excess of ammonium chloride and ammonia.

These facts make it clear that the phenomenon of induced precipitation is of very general occurrence.

The action of copper on 20% nitric acid though slow at the ordinary temperature can be accelerated by the inductor nitrous acid. If two pieces of copper wire are put into two test tubes containing the same amount of 20% nitric acid and one of the tubes kept at rest, whilst the other is vigorously shaken, it will be found that contrary to our ordinary experience the copper in the tube at rest will dissolve much more quickly because the inductor nitrous acid remains in contact with the copper in the tube at rest, whilst in the other case, the inductor is diluted throughout the whole mass of nitric acid.

Copper and Nitric Acid.

On investigating these various cases of induced reactions we were naturally led to the more general conclusion that one chemical change should induce another chemical change of the —*same type* and we tried to verify this conclusion. We found that the reduction of mercuric chloride by such different reducing agents as formic acid. sulphurous acid, phosphorous acid. etc.. induce in all cases the reduction of the same substance. e.g. mercuric chloride, by sodium arsenite. We also investigated other changes as for instance the decomposition of unstable substances. It is well known that ammonium dichromate decomposes readily into nitrogen, water and chromium oxide. also the decomposition temperature of potassium persulphate is lower than that of potassium chlorate, and it has been found that in presence of decomposing ammonium dichromate or potassium persulphate the decomposition temperature of potassium chlorate is appreciably lowered. In this connection it will be of interest to investigate whether the presence of an easily decomposable explosive will lower down the decomposition temperature of a difficultly decomposable explosive, and this investigation will throw light on the velocity of decomposition of mixed explosives.

Potassium chlorate decomposes more readily in presence of decomposing ammonium bichromate or potassium persulphate.

One chemical change will either promote or induce another change of the same nature.

Farmer (Jour. Chem. Soc. 1920, 117, 1603, 1432) has recently shown that the velocity of decomposition of high explosives becomes greater in presence of another explosive which is more readily decomposed. As far our experiments go we are inclined to the view that one chemical change will either promote or induce another chemical change of the same nature.

Mechanism of chemical change.

Radiation is the Motif of all chemical changes.

Being occupied so far with the question of acceleration and retardation of the velocity of chemical reactions, it would not be out of place to say a few words about the velocity itself. Within the last few years a great deal of theoretical work in this direction has been done notably by Perrin and Lewis. In a recent article (Ann. Phys. 1919 (9), 11, 5) Perrin shows that Arrhenius' equation for reaction velocity and temperature can be derived from the Planck or Wien radiation law on the assumption that the chemical action depends on the absorption of a nearly monochromatic radiation. In other words, these investigators postulate that radiation is the entire *Motif* of all chemical reactions, as well as of radio activity and changes of state.

From our experimental work (Proc. K. Akad. Vetensk. Amsterdam, 1920, 23, 308) it has been observed that radiation is an essential factor in a chemical change, although the hypothesis of Perrin is still of a qualitative nature. Recently Langmuir, criticised adversely this hypothesis. Simultaneously with Langmuir Lindemann published a paper (Phil. Mag. Nov. 1920) in which he proved that according to Lewis' radiation hypothesis of the velocity of chemical reactions, the rate of cane sugar inversion in the presence of hydrochloric acid should be about 10–13 times greater in sunlight than in the dark. He adds 'yet the reaction proceeds at appreciably the same rate whether exposed to sun light or not.' Our experiments do not corroborate the above conclusion. We have found that a solution of cane sugar can be completely converted into a mixture of invert sugars at the ordinary temperature by exposing it to tropical sunlight even in absence of acids, and the inversion of cane sugar in the presence of hydrochloric acid is markedly accelerated by sunlight (compare Dhar Zeit. Anorg. Chem., 1920).

It should now be emphasised that there is no fundamental difference between the mechanism of photochemical and thermal reactions. In a photochemical reaction the radiating body is not in thermal equilibrium with the reacting substance as it is in a thermal reaction, and the distribution of energy amongst the different frequencies does not necessarily follow Plancks' distribution law.

From the foregoing remarks it is clear that there is a lot of theoretical and experimental evidence more of a qualitative nature than quantitative, in support of the radiation hypothesis which seeks to establish a connection between chemical changes (thermal, photochemical and catalytic) and radiation. Hence instead of discarding the radiation hypothesis we should try to bring fresh evidence both theoretical and experimental, in support of the hypothesis and try to make it more quantitative.

Absorption of light by some acids and their salt solutions, a new method of determining extinction-coefficient in the ultra-violet.—*By* J. C. GHOSH.

A new method of determining absorption coefficient in the ultra-violet has been described, independent of rotating sector method. The absorption spectra of nitric, nitrous and salicylic acids and their salts have been studied, and it is found that in the last two cases, there is change in absorption spectra on salt formation.

West Coast Sardine Oil.—*By* P. K. KURUP, J. J. SUDBOROUGH *and* H. E. WATSON.

This oil (cf. Report. Ind. Sc. Congress 1920) has been examined from the point of view of refining, hydrolysing with castor seed lipase, reducing (hardening) and sulphonating.

The oil is easily refined provided its acid value is not too high, and can be hydrolysed by castor seed lipase, but requires a relatively larger amount of the lipase than most vegetable oils. It is readily hardened and gives nearly colourless, odourless products. It can be sulphonated but the product is dark coloured compared with Turkey Red Oil.

Preliminary Note on the Chemistry of neem oil.—*By* P. RAMASWAMI AYYAR.

Neem oil in addition to Glycerides of fatty acids contains both an odoriferous principle containing sulphur and a constituent with a bitter taste.

It is shown that the odour of the oil can be removed by partial hydrogenation, and that the bitter principle can be removed by shaking the pressed oil with 87 per cent (by weight) alcohol, or preferably by extracting the seeds first with alcohol to remove the bitter principle and then with ether to remove the oil.

The acids obtained from the oil after removal of unsaponifiable matter have been examined. The method adopted was conversion into methyl esters and fractional distillation under reduced pressure. So far palmitic, stearic and oleic acids have been identified.

The work is being continued.

The investigation of the composition of neem oil and the detection and removal of the impurities.—*By* N. A. YAJNIK *and* Sh. Md. ABDULLAH.

The physical and chemical constants of the oil were determined, and as a result of the experimental work, the following conclusions were arrived at:—

1. The study of the constants of the oil help us a good deal in the investigation of the composition of the oil.

2. The chief cause of the bad smell is the presence of the allyl radical (unsaturated and hence hydrogenation may remove the bad odour).
3. The chief cause of the bitterness of the oil is due to the presence of certain alkaloids—probably quinine and cinchonine or some new ones. The exact alkaloids could not be definitely settled.
4. The oil can be purified for commercial purposes, by first filtering it through animal charcoal (previously heated to red hot temperature) and followed by vigorous treatment with $K_2Cr_2O_7$ and H_2SO_4 in the ratio of 0·75% : 1·5%.

Hydrogenation of oils.—*By* J. W. PAUL.

Catalyser used was reduced nickel. Nickel obtained from its oxalate was an unsuccessful catalyst, that obtained from calcined nitrate was better, but the best catalyst was obtained from nickel carbonate, by heating it for about half an hour, in a current of pure hydrogen, at a temperature between 215–218°C, and then gradually cooling it.

The glass of which the tube, for the reduction of the nickel salt, is made seems to be largely responsible for the activity of the catalyst.

Oils should be hydrogenated in vessels in which the catalyst has been prepared.

Barra oil was solidified to a jelly-like, light pale-green, transparent substance. Til and Mahua oils were also solidified.

The reaction between sodium sulphite and sulphur.—*By* H. E. WATSON *and* M. RAJAGOPALAN.

The conditions of the reaction between sodium sulphite and sulphur in presence of water have been studied. Most of the determinations were made at 60° and 80° at which temperatures the rate can be conveniently measured.

In moderately dilute solutions thiosulphate is formed rapidly: in very concentrated solutions the rate is somewhat less, but in all cases the rate of reaction is very greatly increased by the addition of a large excess of sulphur, and under favourable conditions the conversion to thiosulphate is complete in less than two hours.

Other factors such as the rate of stirring and the effect of catalysts have been studied

Temperature-coefficients of some reactions.—*By* R. C. BANERJI.

The kinetics and temperature-coefficients of the following reactions, which are sensitive to light, have been studied in the dark:—

(1) Oxalic acid and iodic acid—velocity coefficients were deduced from conductivity measurements. The reaction was found to be unimolecular, the temperature-coefficient being 3·27 between 29°C and 59°C; and 2·96 between 59°C and 69°C; and Arrhenius' A calc. according to the equation $\log \frac{K_1}{K_2} = \frac{A\,(T_1 - T_2)}{T_1\,T_2}$ was found to be 5213.

(2) $CCl_3COOH = CHCl_3 + CO_2$.

The change was followed by titration with alkali, and was found to be unimolecular, having a temperature-coefficient of 4·3 between 80°C and 90°C, and Arrhenius' A=8117. HCl or H_2SO_4 gradually increased the total acidity of the solution.

The equilibrium between a mixture of acetic acid and trichoracetic acid and their esters.—*By* D. D. KARVE *and* J. J. SUDBOROUGH.

The Equilibrium :—

$$CH_3.CO_2H + CCl_3.CO_2Et \rightarrow CH_3.CO_2Et + CCl_3\,CO_2H.$$

has been studied at 30°.

At given intervals of time three titrations were made, each with 1 gram of the mixture :—

1. Free acid by titrating with standard ammonium hydroxide using litmus as indicator.
2. Titration in the cold with standard sodium hydroxide with phenolphthalein as indicator. The difference between this and the first titration gives the amount of ethyl trichloracetate.
3. Complete saponification with sodium hydroxide and titration of the excess of caustic soda with standard hydrochloric acid. The difference between the total alkali required for saponification and that used under (2) gives the amount of ethyl acetate in the mixture.

The results show that equilbrium is attained only after some 170 days.

If equivalent quantities of ethyl acetate and trichloracetic acid are used in one experiment and equivalent quantities of acetic acid and ethyl trichloracetate in another, then at equilibrium the ratio of ethyl acetate to ethyl trichloroacetate is always roughly 1 : 1.

The values of the reaction velocities for the changes

$$CH_3\,CO_2H + CCl_3.CO_2Et \rightarrow CH_3.CO_2Et + CCl_3CO_2H$$
$$CCl_3 + CO_2H + CH_3.CO_2Et \rightarrow CCl_3.CO_2Et + CH_3\,CO_2H$$

have also been determined at 30°.

Coagulation of manganese dioxide sol by different electrolytes —*By* P. B. GANGULY.

A sol of manganese dioxide was prepared being stabilised by means of gelatine and the coagulating effects of about thirty different electrolytes were investigated. The minimum quantity of electrolyte necessary to bring about coagulation in a fixed time was found out in every case. The order found did not follow Schulze's law, several of the trivalent and bivalent electrolytes having a far less precipitating power than many of the monovalent ones.

The effects of variation of concentration of the sol were also studied and curves were plotted showing the relations between the quantities of an electrolyte necessary for coagulation and the concentrations of the sol. It has been found that in certain cases, viz. sodium chloride, cadmium nitrate, etc., with the continual increase of the concentration of the sol the quantities of the electrolyte necessary for coagulation first increases and then decreases; in other cases, viz. silver nitrate the quantity of the electrolyte first increases then decreases and again increases with the continual increase of the concentration of the sol. It remains constant in the case of lead nitrate and increases gradually in the case of strontium chloride.

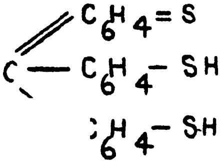
Alcoholysis of the menthyl esters of some $\alpha\beta$-unsaturated acids and of their saturated analogues.—*By* B. DASANNACHARYA *and* J. J. SUDBOROUGH.

The polarimetric method has been adopted for determining the rates of alcoholysis of the menthyl esters of *n*-butyric acid, crotonic acid,

phenylpropionic acid, and cinnamic acid with methyl alcohol and also of the corresponding methyl esters with menthol. Hydrogen chloride was used as catalyst in each case. It is found that the value of the velocity constant is much smaller than when ethyl esters are used in place of the menthyl esters. The effect of the αβ-olefine linking in the crotonate and cinnamate is to reduce the values of *K* to about 1/10th of those for the corresponding saturated esters.

An attempt to prepare red sulphide dyes from dyes of other groups by replacing the auxochromes by mercaptan groups.—*By* E. R. Watson *and* Sikhi Bhushan Dutt.

Benzene-azo—Naphthyl—L-mercaptan, $C_6H_5N=N-C_{10}H_6SH$ (L) was prepared by Leuckart's reaction on benzene-azo—L-naphthyl amine; and tri-*p* sulphydrozy—triphenyl—carbonol anhydride

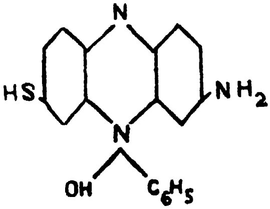


by Leuckart's reaction on *p*-rosaniline.

The former is coloured and soluble in sodium sulphide but gives very poor dyeings from a sulphide vat. The latter is colourless. This result was unexpected in view of the colour of thioindigo red.

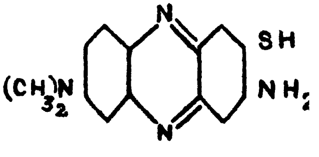
An attempt to prepare red sulphide dyes by introducing mercaptan groups into dyes of the azine, oxazine, phthalein acridine and nitroso groups.—*By* E. R. Watson *and* Sikhi Bhushan Dutt.

Amido sulphydroxy phenazonium hydroxide



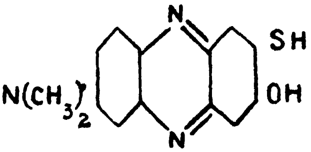
has been prepared by diazotising Safranine B (Apo-Safranine) and subjecting to Leuckart's reaction. It is a sulphide dye but the shade is not interesting, being dull violet.

Dimethyl amino amino sulphydroxy phenazine



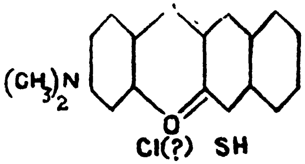
prepared by the condensation of nitroso dimethyl aniline and *m* phenylene diamine disulphide, is a sulphide dye giving reddish brown shades which are however very sensitive to acids and alkalis.

Dimethyl amino hydroxy sulphydroxy phenazine



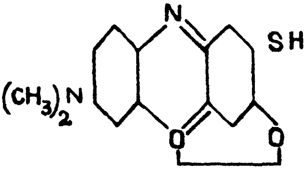
prepared from the above by diazotising and boiling with water is a sulphide dye. The shades are similar but duller than those of the above dyestuff and are also sensitive to acids and alkalis.

Dimethyl aminoe sulphydroxy naphtho phenoxazine



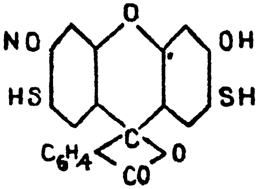
prepared by the condensation of nitrosodimethylaniline and B naphthol disulphide, is dark blue and insol. in sodium sulphide.

Dimethylamino-sulphydroxy phenoxazone



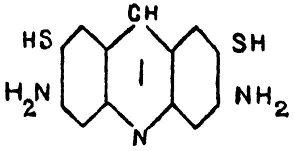
prepared by the condensation of nitrosodimethylaniline and thioresorcin is dark blue and insoluble in sodium sulphide.

Thio fluorescein



prepared by the condensation of phthalic anhydride and thioresorcin is soluble both in caustic soda and sodium sulphide but is not absorbed by cotton from a sulphide vat.

Diamido disulphydroxy acridine



prepared by the condensation of formaldehyde and *m* phenylene diamine disulphide and oxidation of the product with ferric chloride is soluble in sodium sulphide and dyes light brown shades on cotton.

Dinitroso thioresorcin, prepared by the action of nitrous acid on thioresorcin is soluble in sodium sulphide with a brown colour but has little affinity for cotton.

The preparation and properties of azo-dyes containing mercaptan groups.—*By* E. R. Watson *and* Sikhi Bhushan Dutt.

The following new hydroxy mercaptans were prepared as intermediates by Leuckart's reaction on the corresponding aminophenols:—

m. Hydroxy phenyl mercaptan, C_6H_4 OH(1) SH(3)
1 Hydroxy-5-naphthyl mercaptan, $C_{10}H_6$ OH(1) SH(5)
2. Hydroxy-7-naphthyl mercaptan, $C_{10}H_6$ OH(2) SH(7)
3. Hydroxy-5-naphthyl mercaptan, $C_{10}H_6$ OH(2) SH(5)

and the following dyestuffs were prepared from them:—

Benzidine disazo-m hydroxy phenyl mercaptan which is brownish yellow in colour, readily soluble in sodium sulphide and has good affinity for cotton.

Benzidine-disazo-1-hydroxy-5-naphthyl mercaptan is red but only slightly sol. in sodium sulphide and has little affinity for cotton.

Benzidine-disazo-2-hydroxy-7-naphthyl mercaptan is red but only slightly sol. in sodium sulphide and has little affinity for cotton.

Benzidine-disazo-2-hydroxy-5-naphthyl mercaptan is crimson, soluble both in caustic soda and sodium sulphide and dyes cotton.

Benzidine-disazo-L-naphthol polysulphide was prepared by coupling diazotised benzidine with-L-naphthol polysulphide. It has a dull maroon colour is soluble in sodium hydroxide and sodium sulphide but only dyes light shades on cotton.

Benzene-azo-thioresorcin prepared by coupling diazobenzene chloride and thioresorcin is yellowish brown, soluble in soda and sodium sulphide and has good affinity for cotton.

Thiobenzidine disazo-β-naphthol, prepared by diazotising thiobenzidine and coupling with-β-naphthol is scarcely soluble in sodium sulphide and has little affinity for cotton.

Thiobenzidine-disazo-Schaffers salt has the properties of a direct cotton dye.

Thiobenzidine-disazo-L-naphthol polysulphide is brown, soluble in sodium sulphide but has little affinity for cotton.

4. Nitrophenyl-4-mercaptan azo 4-hydroxy phenyl-2-mercaptan C_6H_3 $NO_2(3)$ SH(4) $-N{=}N-$ C_6H_3 SH(1) OH(4) prepared by diazotising 1-nitro-4 aminophenyl mercaptan and coupling with-m-hydroxy phenyl mercaptan is brown, soluble in sodium sulphide and has good affinity for cotton.

These various mercaptan derivatives were prepared in order to study (1) the effect of mercaptan groups in the *o*-position to the azo-linking, as up to the present no such compounds had been prepared and analogy with the o-hydroxy azo dyes made it appear probable that such compounds would give specially fast dyeings; (2) the properties of azo dyes formed from hydroxy naphthyl mercaptans so that the hydroxyl groups would be in the *o*-position to the azo-linking. On account of the insolubility of benzene-azo β-naphthol in alkali, it was hoped that these dyes would be specially fast; (3) the properties of azo-dyes containing mercaptan groups on both sides of the azo-linking.

The action of nitric acid on metals and some alloys.—*By* B. C. Banerji.

It has been observed that metals like copper, silver, lead, nickel and alloys like brass, silver-coin, copper, nickel, etc., dissolve more readily in nitric acid in the presence of ferrous, and ferric salts.

This is contrary to the accepted view.

Oxidising agents like $KMnO_4$, $KClO_3$ H_2O_2, $K_2Cr_2O_7$, etc., markedly retard the rate of solution.

The rate of solution of ferro-nickel alloy in 20% HNO_3 is not uniform, but the change is periodic.

Oxidation of ferrous sulphate by air.—*By* P. K. Banerji.

The rate of oxidation of ferrous sulphate by air does not follow exactly the unimolecular formula, but the oxidation approximates to it.

The average hourly oxidation of a decinormal solution at about 32°C is ·063% when the experiments are spread over 1,488 hours.

Sodium sulphate, magnesium sulphate, zinc sulphate, manganese sulphate, ammonium sulphate. are slight retarders and sulphuric acid and copper sulphate have great retarding effect Only potassium sulphate is a slight accelerator.

Studies on the Dependence of Optical Rotatory Power on Chemical Constitution. Part IV : The Rotatory Powers of Aryl Derivatives of Hisimino-and-aminocamphor.—*By* B. K. Singh, M. Singh *and* J. Lal.

In this paper the rotatory power of the products of condensing camphorquinone with the following diamines are described:—

(*a*) hydrazine; (*b*) benzidine; (*c*) tolidine; (*d*) dianisidine, (*e*) p, p', diamidodiphenylamine.

Benzidine and tolidine give two different products, whereas dianisidine gives only one. The two forms are regarded in each case as geometrical isomerides, since in the case of benzidine both the products give the same amino-derivative on reduction.

The effect of ortho-substitution on the rotatory power of p, p', diphenylene-bisiminocamphor ($[M]_D$ 5432° and 5472° in chloroform) is remarkable. It is accompanied by lowering of rotatory power as in the cases of o, o', ditolylenebisiminocamphor ($[M]_D$ 3911° and 4007°) and o, o', dimethoxyphenylenebisiminocamphor ($[M]_D$ 2003°) The sequence of the substituent element or group in the order of diminishing rotatory power in this series is $H > CH_3 > OCH_3$.

The product of condensing camphorquinone with p, p', diamidodiphenylamine is remarkable in several ways. It possesses the highest molecular rotatory power hitherto recorded ($[M]_D$ 14740° in pyridine), and even exceeds the molecular rotatory power of 1 : 4 Naphthylenebisiminocamphor (Singh and Singh T. 1920, *117*, 1599). The substance is also one of the very few optically active dyes known. It is both thermotropic and phototropic.

The production of acetone from acetates and acetic acid.—*By* M. G. Kekre, J. J. Sudborough *and* H. E. Watson.

Comparative experiments have been carried out on the yields of acetone from magnesium, calcium and barium acetates when distilled. Barium acetate was found to give the highest yields. In another series of experiments the continuous production of acetone from acetic acid by means of catalysts has been studied, the catalysts used being the acetates of magnesium, calcium, barium and manganese and pumice. Yields of 80 to 90 per cent have been obtained.

The experiments were all conducted in a small iron retort heated by means of nicrome resistance wire.

Certain observation on a surface-tension phenomenon —*By* P. B. Ganguly *and* B. C. Banerjee.

It was observed that when a stick of an easily soluble substance was held vertically suspended in water in such a way that only about half of the stick was under water, a well marked stricture was formed about the point where the stick came in contact with the surface of the water. The above was found to be a general case with sticks and regular shaped crystals of soluble substances.

Dissolution of metal rods by acids under similar conditions showed the same effect though to a lesser degree.

The reverse effect was observed when a rod of iron was suspended in a solution of copper-sulphate, a raised ring being formed about the junction of the rod with the surface of the liquid.

· The above phenomena can all be explained on the basis of surface tension.

Surface tension of soap solutions for different concentrations.—*By* A. L. Narayana *and* G. Subrahmanyam.

Accurate measurements of surface tension of solutions of sodium oleate, and pure castyl soap used for water analysis, are made by the capillarity method, and by the bubble method.

For the accurate measurement of pressure inside a bubble an improved manometer is constructed, which surpasses other types both in quickness and delicacy of action.

The experiments prove :—

(*i*) Surface tension of soap solution is same at all concentrations between wide limits.

(*ii*) The angle of contact between glass and the solution in air is zero.

(*iii*) The reliability of the bubble method for studying the surface tension of soap solutions.

Molecular conductivity of potassium iodide in organic solvents.—*By* N. A. Yajnik *and* B. R. Sobti.

1. The molecular conductivity of potassium iodide in (*a*) methyl alcohol; (*b*) acetone; (*c*) pyridine; (*d*) epichlorohydrin; (*e*) furfural; (*f*) brenzaldehyde; and (*g*) nitrobenzene, as solvents, was investigated.

2. As a result of the experimental work, it was found that :—

(*i*) In all cases conductivity increases as we increase the dilution.

(*ii*) It cannot be held that the dissociative power of a solvent is in direct parallelism to the dielectric constant.

(*iii*) The relation between viscosity and conductivity, as pointed out by certain investigators, was not found to hold good strictly but certain exceptions to the above rule, were observed.

Study in viscosities of cobalt, copper and mercuric chlorides with a view to find the constitution of the complexions formed in the solutions.—*By* N. A. YAJNIK *and* RAM LAL UBEROY

1. The viscosity of solutions of single salts at different concentrations was studied. The salts examined were the alkali chlorides and the chlorides of copper, cobalt and mercury.

2. After the investigation of the viscosity of solutions of single salts, the viscosity of the binary mixtures of chlorides of cobalt, copper and mercury with alkali chlorides were studied in two ratios.

3. The following conclusions were arrived at:—

(*i*) In case of solutions of single salts, very little relationship was noticed between viscosity and concentration.

(*ii*) In case of binary mixtures, when the viscosities in two different ratios were compared, it was found that the composition of the complexion in case of cobalt, copper and mercuric chlorides, with alkali chlorides, was nearer to M_2 (M^ICl_4) than to M (M^ICl_3). The slight deviation may be accounted for by association or hydration taking place.

On the stability of chromates at high temperatures.—*By* M. RAMAN NAIR *and* H. E. WATSON.

Experiments have been carried out on the equilibrium between chromium trioxide and bases in presence of air at different temperatures. Calcium chromate is slowly formed from lime and chromium trioxide at 650° but begins to decompose at about 750°. Excess of lime increases the rate of formation and increases the amount of decomposition at higher temperatures.

Pure sodium chromate could only be studied over a limited range of temperature owing to its fusibility, but a mixture of lime, sodium carbonate and chromium trioxide in the equivalent proportions 1·7 : 0·65 : 1 gave a quantitative yield of chromate in 4 hours at 660° and in 5 minutes at 1050°. Curves showing the relationship between percentage decomposition and temperatures for different mixtures have been determined.

Radioactivity of some Indian minerals.—*By* N. A. YAJNIK *and* S. J. KOHLI.

1 Comparatively little work has been done, in India, on the important subject of radioactivity. The radium content of a great many Indian minerals is consequently unknown. It was, therefore, thought advisable to carry out some investigation in this direction.

2. Joly's solution method was used in the present investigation. The solutions in every case, were kept at least for three weeks and then examined For examination a Bumstead Double Electroscope with a slight modification was used.

3. Out of the minerals sent by the Geological Survey Department of India, Uranium Ochre and Samarskite were found to be the most active their radiun content being 21434 × 10—12 and 11887·2 × 10—12 gm. per gm. respectively. While these two minerals are not very abundant in India, another mineral apatite magnetite, with yellow incrustations appears to occur in large quantities and its radium content was found to be 1324·9 × 10—12 gm. per gm. The other minerals examined appear either to be too rare to be of any practical value or have very little radium content.

4. Besides these, some minerals from Travancore and some samples of Bauxite from Kashmir State were examined and were found to show some activity.

Poppy petals.—*By* J. N. Rakshit *and* S. N. Singha.

Poppy petals from several districts of the United Provinces were examined for ash, extract, invert sugar and tannin.

Note on the Liesegang Phenomenon.—*By* N. G. Chatterji.

(1) Peptisation of silver chromate takes place much better when silver nitrate is added to a solution of potassium dichromate in gelatin than the reverse.

(2) Peptisation of the hydroxides of cobalt, iron and other metals takes place in exactly the same way in presence of gelatin, agar-agar, gum-arabic and starch as in that of glycerine.

(3) Periodic precipitation was observed in the case of cobalt hydroxide in gelatin and of mercuric iodide in silicic acid gel.

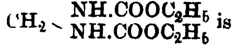
(4) Peptisation is an important factor in the phenomenon of periodic precipitation.

Supersaturation and periodic precipitation.—*By* K. R. Krishna Aiyer *and* K. R. Ramanathan.

Periodic precipitation similar to that observed in jellies (the Liesegang phenomenon) may be brought about even in the absence of jellies by allowing one of the reacting substances to diffuse into the other under the conditions described. The explanation of Ostwald that the phenomenon is due to spontaneous crystallisation from a supersaturated solution at the metastable limit is upheld. Photographs are shown in illustration.

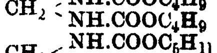
Some derivatives of carbamic esters. Chlorine as a simultaneous oxidising and condensing agent.—*By* R. L. Datta *and* B. C. Chatterjee.

It has been found that when chlorine is passed into carbamic esters in alcoholic solution, the alcohol is oxidised to the corresponding aldehyde which immediately condenses with the carbamic esters to form dicarbamic esters.

With methyl alcohol and ethyl carbamic ester, methylene diurethane  $CH_2 < \begin{matrix} NH.COOC_2H_5 \\ NH.COOC_2H_5 \end{matrix}$ is formed. In a similar manner, the following compounds have been prepared; methylene dicarbamic methyl ester

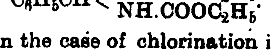
$CH_2 < \begin{matrix} NH.COOCH_3 \\ NH.COOCH_3 \end{matrix}$, methylene dicarbamic propyl ester,

$CH_2 < \begin{matrix} NH.COOC_3H_7 \\ NH.COOC_3H_7 \end{matrix}$ methylene dicarbamic isobutyl ester,



$CH_2 < \begin{matrix} NH.COOC_4H_9 \\ NH.COOC_4H_9 \end{matrix}$ methylene dicarbamic isoamyl ester,

$CH_2 < \begin{matrix} NH.COOC_5H_{11} \\ NH.COOC_5H_{11} \end{matrix}$ benzylidene dicarbamic ethyl ester,



$C_6H_5CH < \begin{matrix} NH.COOC_2H_5 \\ NH.COOC_2H_5 \end{matrix}$.

In the case of chlorination in ethyl alcohol medium, the alcohol gets chlorinated and at the same time oxidised to aldehyde which finally condenses with urethane to form dichloroethylidene diurethane

$CHCl_2.CH < \begin{matrix} NH.COOC_2H_5 \\ NH.COOC_2H_5 \end{matrix}$. In the case of substituted urethanes such as phenyl urethane and α-naphthyl-urethane, the same type of reaction takes place but on account of the reactivity of these aromatic groups, they get chlorinated at the same time. With phenylurethane in methyl alcohol, methylene di-*p*-chlorodiphenylurethane $CH_2 < \begin{matrix} C_6H_4Cl.NCOOC_2H_5 \\ C\ H\ Cl.NCOOC_2H_5 \end{matrix}$ is formed. With α-naphthylurethane and methyl alcohol, methylene di-tetrachloro-α-naphthyl diurethane $CH_2 < \begin{matrix} C_{10}H_5Cl_2N.COOC_2H_5 \\ C_{10}H_5Cl_2N.COOC_2H_5 \end{matrix}$ is produced. The above type of condensations falls through in the case of secondary alcohols.

It has also been found in this connection that ethyl monochlorocarbamic ester undergoes hydrolysis to a cyclic compound, diethy-4-cloro-methyl cyclomethylene hydrazine imide 1·3-di-carboxylate $CH_2Cl\ CH < \begin{matrix} N.COOC_2H_5 \\ \searrow NH \\ N.COOC_2H_5 \end{matrix}$ which form an imide chloride and an acetyl derivative. Dichlormethylcarbamic ester, $NCl_2.COOCH_3$ has also been prepared for the first time passing chlorine through an aqueous solution of methyl carbamic ester.

Purification of crude nitre.—*By* B. Ganapathi Rao, J. J. Sudborough *and* H. E. Watson.

The refining of crude nitre at temperatures between 55 and 100°C has been tried with the object of obtaining a purified product containing as little sodium chloride as possible. The solubility values of sodium chloride in saturated potassium nitrate solutions determined by Etard (Ann. Chem. Phys., 1894, (VII) *3*, 283) indicate that 55 to 60° is the most suitable, and excellent results can be obtained at this temperature. Higher temperatures up to 100°C have also been tried, and, with the proper adjustment of water to compensate for the increased solubility of the sodium chloride and for the evaporation of water during digestion of the crude nitre and cooling of the solution, the amount of common salt has been reduced below 0·3 per cent. For practical purposes 80–85°C is found to be the most convenient temperature for the digestion. An efficient method has been worked out whereby, by one crystallisation white crystals of nitre can be obtained containing not more than 0·2 per cent sodium chloride, whilst the amount of potassium nitrate in the residue or 'sitta' is reduced to below 3 per cent which is equal to a loss of 5 per cent of the total nitrate present.

The solubilities (in water) of the following three systems (1) NaCl, Na_2SO_4; (2) Na_2SO_4, KNO_3; (3) Na_2SO_4, NaCl, KNO_3 have been determined between the temperatures 22°–96·5°C. The possibility of (*a*) sodium sulphate interfering with the purification of nitre and (*b*) double decomposition between the salts present has been considered Attention is drawn to the importance of the latter in processes of extraction.

The extent and character of the reh deposits of the United Provinces and the possibilites of their commercial utilisation —*By* E. R. Watson *and* K. C. Mukerjee.

By analysis of samples taken from the large *usar* plains between Cawnpore and Lucknow it was found that not all *usar* plains contain alkaline salts in any quantity.

A tour was made over all the main lines of rail in the province and the areas showing efflorescence were noted.

Samples were taken systematically from the largest efflorescent area observed from the railways, viz. an area which extends about thirty miles along the E.I. Railway south of Etawah. These samples were analysed and showed considerable variations in composition, the average being about 5 per cent of soluble salts in the first inch of soils and a ratio of 2 : 1 between carbonate and sulphate.

It was estimated that this one area could supply 37,000 tons of soda ash per annum and the total province five million tons.

The soluble salts contained in these *reh* deposits are chiefly sodium carbonate and sodium sulphate with some organic matter.

Experiments are described to show to what extent it is possible and might be profitable :—

(1) To obtain sodium carbonate (of the degree of purity demanded in the trade) by recrystallisation.
(2) To obtain a better separation by passing in carbondioxide to convert the carbonate into bicarbonate.
(3) To convert the salts completely into carbonate by the black ash process.
(4) To convert the salts completely into carbonate by a modification of the black-ash process (omitting calcium carbonate).

The manufacture of trinitrotoluene from Assam and Burma petroleum.—*By* E. R. WATSON.

Both Assam and Burma petroleums contain a considerable quantity of aromatic hydrocarbons.

Processes for making trinitrotoluene from these petroleums are described in Indian Patents Nos. 6802 and 7449 of 1921.

The importance of these processes lies in the fact that they put India in a position at once to manufacture all her own explosives from materials available in India, without waiting for the development of a large coal-tar and coking bye-product industry.

Laboratory experiments are now described showing that no larger quantities of acids are required for the manufacture of trinitrotoluene by this process than in the ordinary process, and the process is now being tried on a semi-large scale at the Government explosives factory at Aravakandu, South India.

Phototropy of inorganic salts.—*By* GOPAL SINGH.

Cuprous chloride and bromide in presence of water, have been found to be phototropic. An attempt has been made to explain this phototropism.

Photo-chemical catalysis.—*By* A. K. SANYAL.

Ferrous, ferric, manganese, chromium, and cobalt are positive catalysts whilst chlorine, bromine and sodium sulphite have been found to be negative catalysts in the following photo-chemical reactions: (1) $HgCl_2$ and $(NH_4)_2\ C_2O_4$; (2) $CuSO_4$ and $(NH_4)_2\ C_2O_4$; (3) $Hg(CN)_2$ and $(NH_4)_2\ C_2O_4$; (4) $(NH_4)_2\ C_2O_4$ and I_2; (5) Fehling's solution.

Freshly prepared salts of lead and bismuth were exposed to direct sunlight and it was observed that in general the freshly precipitated ones were more photo-chemically active than those which had been kept for a long time or have been boiled for a long time

South Indian Wattles.—*By* C. SRINIVASAN.

The paper summarises the results of an investigation of the tannin content, optimum temperature of extraction and tanning properties of the bark of the Acacia Decurrens found in South India, indicates how the tannin content varies with age and discusses the question of the Wattle Extract Industry in relation to Wood Distillation in South India.

A note on some tartrates.—*By* K. P. CHATTERJEE.

In my general investigation on the influence of temperature on precipitation by double decomposition, when strong solutions are mixed, the following are some of the new tartrates obtained :—

(1) Two varieties of cobalt tartrate of the formula $Co(C_4H_4O_6)$, $2\frac{1}{2}H_2O$, and also the anhydrous salt $Co(C_4H_4O_6)$: (2) magnesium tartrate $Mg(C_4H_4O_6)$, $2\frac{1}{2}H_2O$ and also the anhydrous salt; (3) manganese tartrate $Mn(C_4H_4O_6)$, $2H_2O$ and the anhydrous salt; (4) complex copper potassium tartrate $2Cu(C_4H_4O_6)$, $K_2(C_4H_4O_6)$, $3H_2O$ and the anhydrous salt; (5) strontium tartrate $Sr(C_4H_4O_6)$,H_2O and the anhydrous salt.

The formulae of these salts have been determined by a number of methods and the properties have been studied. Their molecular volumes have also been determined, in which a general confirmation of the accepted molecular volume of water of crystallisation, has been obtained.

Some investigations on indigo hydrosulphite vat textile dyeing.—*By* N. A. YAJNIK *and* D. R. SARNA.

1. It was found by careful investigation, that pure indigotine, the principal colouring matter of natural and synthetic indigo, extracted after B.A.S.F. method, could be best reduced, with N.F. hydrosulphite, in an alkaline medium, at the temperature of 60° to 8)°C, and in the proportion of 1 : 1·6 by weight.

2. The presence of alkalies say NaOH or $Ca(OH)_2$ in addition to acting as solvent to indigo white, effect indigo textile dyeing. The maximum shade was obtained by the addition of NaOH slightly greater than three times the weight of their chemical equivalents in hydrosulphite vat set in the above proportions, below or above which there was an appreciable decrease in the percentage of coefficient of absorption of indigo by the fibres, i.e less deep shade.

3. The presence of very small amounts of boric acid, acetic acid, etc., was found to increase the maximum shade, keeping all the factors the same. The nature of the reactions involved is not understood at present but the additions to the vat are highly recommended owing to :—

(*i*) Control of over-reduction.
(*ii*) The chances of oxidation of indigo white being minimized owing to its keeping in colloidal form.
(*iii*) The increased absorption of dye, i.e. maximum shade obtained with the least amount of indigotine.

The whole problem rests on finding out the products of over-reduction and the condition and nature of cellulose in the vat.

Laboratory experiments on the manufacture of Portland cement from materials available in the United Provinces. —*By* E. R. WATSON, K. C. MUKERJEE *and* N. G. CHATTERJEE.

Chemical analysis indicates that the chief drawbacks for cement making in the United Provinces are (1) deficiency of material containing a high percentage of calcium carbonate; (2) too high a percentage of magnesia in many materials.

But according to chemical analysis satisfactory cement should be made from :—

(1) Marl from near Lucknow and the adjacent clay (see Hallidy's report to the Railway Board).

(2) Kunkar from near Cawnpore and Sutna limestone.

Experiments have been made to prepare on a small scale satisfactory samples of cement from these materials and our experiences are described as regards (1) calculating the correct proportion for the mixture ; (2) effect of varying the proportions on the properties of the cement; (3) effect of burning at different temperatures.

Brominated Isocyamines —*By* K. L. MOUDGILL.

Three bromoderivatives of sensitisers of pinaverdol and pinacyanol type have been synthesised and the influence of the presence of an atom of bromine in the benzene ring of the quinaldine nucleous studied. The region of sensitiveness shifts towards the red end of the spectrum and the intensity of sensitiveness is considerably reduced.

Some induced oxidations.—*By* N. N. MITTRA.

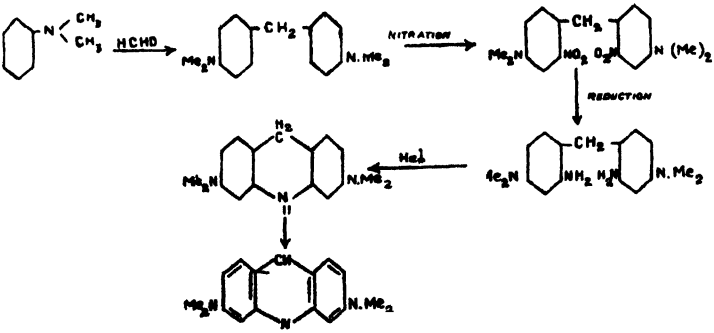
It has been observed that sodium sulphite, sodium phosphite, and formic acid can induce the reduction of mercuric chloride by sodium arsenite.

The oxidations of ferrous hydroxide, cobaltous hydroxide, and manganous hydroxide can induce in each case the oxidation of potassium oxalate by oxygen gas.

Attempt has been made to explain these reactions.

Tetramethyldiaminoacridine.—*By* K. L. MOUDGILL.

Three different methods of preparation of the compound are described and the yields discussed. The best results were given by the method outlined below.



New methods of preparation of 2 : 4 dinitrodimethylaniline and 3 : 3′ dinitro 4 : 4′ tetramethyldiaminodiphenylmethane are described.

Dyes from camphoric anhydride.—*By* A. C. SIRCAR *and* S. B. DUTT.

In this paper the authors have shown that camphoric anhydride can be made to condense with various hydroxy and amino compounds yield ing condensation products, which possess interesting tinctorial and flourescent properties, similar to the corresponding floureseeious, Eosius and Rhodamines obtained from phthalic anhydride, anphthalic anhydride or quinolinic anhydride. A good number of such condensation products have been described.

The study of iodine absorption of certain Indian vegetable oils.—*By* N. A. YAJNIK *and* M. RAJ.

1. A comparative study of the iodine value of certain Indian vegetable oils was carried on by four different methods, viz. Hubl, Wijs, Hanus, and Winkler's Bromate Bromide method.

2. Iodine number of certain Indian oils such as neem oil, soap nut oil, sukhchain oil, which have not been studied previously, was determined for the first time.

Experiments on the constitution of longifolene —*By* J. L. SIMONSEN.

Experiments which have been made with the object of elucidating the constitution of the sesquiterpene, longifolene, were described.

The constituents of some Indian essential oils.—*By* J. L. SIMONSEN.

The constituents of the following oils have been determined: from the resins of *Pinus khassya* and *Pinus excelsa*, from the leaves of *Abies webbiana*, from the seeds of two species of *Xanthoxyllum*.

Note on some new oils and fats.—*By* M GOPAL RAU.

The oils (or fats) from the following seeds have been examined in detail: *Mimusops elengi*. *Garcinia cambogia*, *Payena oleifera*, *Chlorolexylon sweetania*, *Calophyllum wightiana*. The acids obtained on hydrolysis of the oils were separated and identified.

Section of Zoology.

President:—Dr. N. ANNANDALE. F.A.S.B.

Presidental Address.

ETHICS OF ZOOLOGY.

In his introduction to the eighty-third section of the *Ain-i-Akbari* Shaik Abulfazal wrote of Akbar.

> "His majesty has taught men something new and practical and has made an excellent rule, which protects the animal, guards the stores, teaches equity, reveals the excellent, and stimulates the lazy man." (Blochmann's *Ain-i-Akbari*, Vol. I, p. 217.)

Let us constitute ourselves humble followers of Akbar and strive to find a rule that will at once protect the animal, guard the stores of zoological learning, maintain equity between zoologists and stimulate the excellent, if not the lazy man to sound zoological research.

Sir William Jones in his inaugural discourse to the Asiatic Society, delivered in Calcutta in 1784, omitted zoology from the proposed agenda of the Society. Nine years later, in his tenth address he explained the reason. "Could the figure, instincts, and qualities of birds, beasts, insects, reptiles, and fishes," he said, "be ascertained, either on the plan of Buffon, or on that of Linnaeus, without giving pain to the objects of our examination, few studies would afford us more solid instruction or more exquisite delight."

He went on to state that he could not conceive of the feelings of a naturalist who could occasion the misery of an innocent bird, "or, deprive even a butterfly of its natural enjoyment, because it has the misfortune to be rare or beautiful." He then gave the following translation of a couplet of Firdausi:—

"Ah! spare yon emmet, rich in hoarded grain;
He lives with pleasure, and he dies with pain."

Elementary as was Sir William Jones's concept of zoology, his opinion as a scholar and a poet cannot be dismissed lightly. There is, as the French say, nothing that kills like ridicule, but ridicule kills only when its object is really ridiculous. To laugh at what is true and solid is merely to exhibit lack of sympathy and sense.

There seems to me, however, to be some confusion of thought in Sir William Jones's statement, which I have not quoted in full, and, moreover, he has ignored the fundamental difference in the point of view of a man whose attitude towards animals is entirely religious as a believer in the transmigration of souls and the accumulation of merit, and that of one whose dislike of cruelty is ethical and aesthetic. Firdausi's couplet expresses the views of the latter, the edicts of Asoka those of the former, for the edicts are directed not against cruelty to animals but against the destruction of life.

No decent zoologist is cruel to animals. Indeed, among civilised men, there is something antagonistic to human sanity in deliberate cruelty; it is essentially morbid and unnatural. But there is another kind of cruelty, due mainly to lack of imagination and carelessness. In watching a carter twisting the tail of his ox to believe that his motive is entirely free from vicious pleasure it is difficult, but we may concede that it is mainly due to a lack of the intellectual ability to conceive the feelings of the ox. Curiously enough this minor type of cruelty is often prevalent among those to whom the religious motive is all-important.

It is a custom in Japan to throw the laboratories of the Imperial Universities open to the public once a year, and to provide a popular exhibition of scientific apparatus and preparations. In 1915 I happened to be in a Japanse university town in which an exhibition of the kind was in progress. The main exhibit in the physiological laboratory was a living rabbit firmly tied down and cut open in such a way as to illustrate the beating of the heart. Even supposing that the rabbit was completely anaesthetized, the exhibit was a disgusting one from a Western point of view, and would probably have caused a riot in England, even before the police intervened; but in Japan, women and children examined it with perfect equanimity, and my friends of the university staff could not see anything wrong. And yet these very professors and lecturers were in the habit every year of holding a solemn service of expiation in one of the great Buddhist monasteries of the city for the souls of the animals which had been dissected in their laboratories.

It is an interesting speculation whether the Japanese crowd would have viewed the vivisected rabbit with the same equanimity if it had chanced to be one of the animals of which the representation in painting is permitted by the narrow canons of Japanese art. I must confess that my own objections to the exhibition were just as much aesthetic as moral.

The study of zoology in India has not, as a matter of practice, been much affected by the edicts of Asoka, and the remarks of Sir William Jones on the supposed cruelty involved in zoology had no more than a temporary effect on the history of the Asiatic Society. Indeed, it seemed at times as if the stone the builder had rejected had become the headstone of the corner, for in the days of Blyth and again in those of Alcock, zoological papers were amongst the most important published in the Society's Journal. Nevertheless, it is as well that in our zoological work we should keep in mind both Firdausi and Piyadasi.

I need not waste your time on the crank who loves her dog and hates mankind.

Scientific work is plain-sailing as long as a man can do it alone. It is when he has to consider others that the strain and difficulty begin. There is one point, small in itself but still important, in which I notice that my younger colleagues experience peculiar difficulty, namely in acknowledging the help they have received from their seniors. The matter is not so simple as it seems. Two pitfalls must be avoided, that of flattery on the one hand and that of plagiarism on the other. For Indians there is the added difficulty of a foreign language, for there is nothing more difficult than to pay a graceful compliment in a language not one's own. Delicacy of feeling, moreover, is often necessary to distinguish between a common courtesy and subtle flattery. The best way out of the difficulty is to say frankly what help has been received and to express gratitude in as few words as possible.

The question of plagiarism is even more difficult in scientific research than in literature. If Shakespeare, as some of my younger colleagues would argue, was justified in appropriating a commonplace plot and transmuting it into a work of genius, we also are justified in using the ideas of other as our own. Unfortunately few of us are Shakespeares; or Darwins. Darwin was one of the most modest of men, and always most scrupulous in acknowledging assistance of any kind, even, or perhaps especially, from those whose lights were much less than his own. In acknowledging help, whether from the written or the spoken word, we cannot do better than accept the introductory part of the *Origin of Species* as our guide.

But this does not dispose of the more general question of plagiarism. How much may be legitimately appropriated, or may anything be appropriated at all ? In the Roman Church St. Alphonso of Ligouri, the one modern Doctor of the Church, is accepted as the final referee on ethical questions. He was bold enough to draw up a tariff of mortal sin in theft. He ruled that in certain circumstances a respectable man who stole a shilling from a working man or fourteen shillings from a crowned head, did not commit a mortal sin; but that to steal even a few farthings from a beggar was always a mortal sin. In scientific ethics we have no such authority as St. Alphonso; but the rule that nothing whatever should be taken from any living person without due acknowledgment is a good one. We must steal not at all, either from king or beggar. There are, however, in science as in literature many ideas and phrases so universally understood and accepted that to trace them to a personal origin is not only unnecessary but also a little ridiculous. Even such ideas and phrases, if attributed to an author, should be attributed correctly. For example, the saying that a practical man practises the follies of his ancestors is often attributed to Huxley, but really emanated in the first instance from Disraeli, in whose *Coningsby* it is placed, with many other self-evident sentiments, in the mouth of the wise Jew Sidonia.

The mention of Huxley leads me to a point almost universally ignored at the present day in the ethics of zoology—the importance of literary style in the presentation of scientific facts and ideas. If anything is worth saying it is worth saying well. You have all heard of Buffon, who used to put on his court dress and his sword whenever he sat down to write. Such external ceremony is perhaps contrary to the spirit of this age and may, therefore, appear to some of us to have been mere affectation on Buffon's part; which it certainly was not. Scientific facts, however, are worthy of respect, and should be treated with due decorum. Style has been defined as saying things in a clear and appropriate manner. It is not appropriate to couch a plain statement of facts in highly figurative or elaborate language. Plain facts must be stated plainly. Our aim in zoological literature must be chaste simplicity, but journalese is not simple, nor is it chaste. Superfluous words, words issued to startle or confound without thought of their precise meaning, in short all idle words, merely recall the saying that language was given to man to conceal his thought If, however, you adopt the telegraphic style in description—and nowadays economy in print is always desirable for financial reasons —do so only in mere diagnosis, and even in diagnosis be adequate, and be consistent. It is neither economical nor grammatical to write in describing an insect: "body black; the legs are brown."

I would advise every zoologist to study Sir Arthur Quiller-Couch's lectures. *On The Art of Writing.* He will find some hard sayings. With many others, I have found the statement that a case can only mean a box not a little disconcerting, from both a philological and a literary point of view but the fact that such statements make us feel uncomfortable proves that they contain an element of truth.

Apart from literary style in the writing of zoological papers, the question of the mechanical preparation of the manuscript for the press is one of ethical significance. As editor of the *Record* and *Memoirs of the Indian Museum* I often receive manuscripts that need many hours' careful and troublesome work before they can be sent to the printer. If it were not for the fact that Dr Kemp is kind enough to relieve me of much of this drudgery, I would scarcely hesitate to refuse to consider a great part of the matter submitted for publication. Carelessness or ignorance as to punctuation and the use of capitals is rife, and few authors take any trouble in indicating the use of italics or other special type. It is surprising how few zoologists know even such elementary rules as that of the proper use of brackets with the names of the authors of species. These names should never be enclosed in brackets, unless the name of the genus of the species has been changed since the latter was first described. These may seem trivial points, but their neglect indicates not only carelessness, but selfishness and lack of understanding.

Zoology has become so complicated that few of us nowadays are more than "Scarabees." This is an immoral state, not only because no man has the right to narrow his interests to a single family of beetles, but also because the whole of biology is at present encumbered with uncoordinated details that clog the machinery of progress instead of acting as motive power.

In zoology, however, as in all branches of knowledge, it is worse than being narrow-minded to assume an interest if we have it not. One of the most unpleasant persons I ever met was a young student who emerged from a very dirty house in Iceland and remarked: "Good-morning! Do you think Lord Verulam wrote the plays of Shakespeare?" He took no more interest in the Shakespeare-Bacon controversy than I did in Icelandic politics, but wished to impress the foreigner. You may apply this parable to zoology as you like.

In recent years zoological controversy, like most other branches of criticism, has grown more refined. but we are still far from the urbane irony which an American critic regards as one of the highest manifestations of the literary spirit in modern England. Courtesy is apt to degenerate into irresponsible and often irrelevant insinuation, such as that of an anti-Indian spirit in this country, or of slackness in war in Europe. In some branches of zoology, notably in pure taxonomy, opinions are so varied that no general consensus seems possible. I have observed a tendency among young zoologists in India to treat conclusions, based presumably on ascertained facts, somewhat lightly, in order to avoid controversy—as in the case of a young man who brought to a friend of mine a paper in which far-reaching conclusions were derived from somewhat meagre research My friend pointed out that the evidence hardly justified the conclusions. "Oh", said the author but I can change the conclusions!"

On the other hand, it is quite unnecessary to call a man a liar because you disagree with him on some controversial point, or even on some matter of observation. All men cannot think. or even see. alike, and because a man is senior to one's self, or belongs to a different race, he is not necessarily wrong. If the majority of zoologists were endowed with a sense of humour (which, after all, as Thackeray has pointed out, is essentially the same thing as a sense of proportion) much controversy would be avoided altogether, the real point at issue not being any point of fact or even of interpretation but merely some personal fad, jealousy or spite. I was once buying some sleeping mats in the Malay State of Kelantan The man who had brought them for sale stated that it had taken him two months to make them. I turned to another Malay who was standing by—an uneducated man, but endowed with the ready wit and delicacy of feeling so characteristic of the Malay race—and enquired if this could be true "Doubtless, *Tuan*," was the reply, "but perhaps he only worked one day in each month." The retort was a retort courteous; no offence was caused, and the bargain was concluded in a manner satisfactory to all concerned.

The true test in all controversy is the inner feelings of the disputants. So long as a man respects his opponent and feels no bitterness towards him, controversy is a good thing; but in scientific controversy there must be no reservations, no quibbling. We must play with all our cards on the table. A plan I have adopted in the *Records of the Indian Museum* seems to me a good one. Some years ago I published a paper in the *Memoirs of the Asiatic Society of Bengal* in which I pointed out that there was considerable diversity in the frogs usually grouped under the name *Rana tigrina.* I, therefore, suggested that several distinct species should be recognised. Dr. G A. Boulenger, then in charge of the Reptiles and Batrachia in the British Museum and still recognised as the leading herpetologist in Europe. did not agree with me He paid me the great compliment of sending me a paper for publication in the *Records of the Indian Museum*, refuting my claim for the specific recognition of the different forms of *Rana tigrina*, which he regarded as merely races or varieties. In certain points Dr. Boulenger was evidently right and I wrong. So I wrote a second note expressing my views as modified by Dr Boulenger's argument Of this I sent the manuscript to him ; and he replied in a third note. The three notes were then published together as a kind of dialogue, so that all the facts and arguments of the case were submitted to the zoological world together, without the slightest bitterness, loss of mutual respect, or ill-feeling on the part of either the senior or the junior author Far otherwise was it with the famous controversy on the proper generic name of the bed-bug that raged round the world some years ago from Hawaii to Belgium and from England to Canada.

In setting forth this ideal of urbane controversy I do not mean to say that there are not cases in which the experienced zoologist does well to be angry Dishonest or grossly careless work, work done merely for the sake of effect or to satisfy the investigator's personal ambition or further his official promotion, must always meet with unqualified condemnation, in which there is no room for mutual respect or personal feelings of any kind

In the official document whereby the Zoological Survey of India was constituted in 1916, our relations with the technical departments are laid down as being those of "co operation without subordination" The thanks of all Indian zoologists are due to the man who discovered this formula—I do not know his name. The formula implies not only the recognition of pure zoology on the part of the Government of India, but also its independence of direct economic aims. I have nothing to say against applied science, provided that it is science at all, but the term is often "applied" to something akin to the Holy Roman Empire, which has been described as neither holy, Roman, nor an empire.

Even in the purely physical branches, in which the mathematical demonstration of facts is possible, "practical results" often rest on a very small basis of research. The whole affair is in fact an inverted pyramid, liable to topple over at any moment and overwhelm its supporters. As soon as the question of life enters into applied science the matter becomes vastly more complex and just as the life of the animal is more complex than that of the plant, so is applied zoology more difficult than applied botany. Some day we may know something about life, and understand how a plant or an animal lives, how and why it reacts to its environment. At present we know practically nothing. The great triumphs of applied biology are empirical, such as the discovery of the value of cinchona bark ages before the malaria parasite was known. And yet they are triumphs of pure research, for research is only experiment and its interpretation. The practical knowledge of the primitive fisherman or agriculturist is based unconsciously on the experience of thousands of years. At present all we can do in a laboratory or a museum is to speed up experience, to attempt to learn in a few months or years what the peasant has taken centuries to learn, and has sometimes learned wrong in the end.

Applied zoology should be, and perhaps some day may become, the great philanthropic agent of the world. At present, it is often a wolf in sheep's clothing, a devil masquerading as an angel of light. No government or commercial body can resist the temptation of demanding results, and in India we hear of even professors expecting from their students "a research a month". Such demands often meet with a ready response from the young and ignorant. This can only result in a furtive and subtle dishonesty fatal to all true progress. I am firmly convinced that applied zoology is at present, with our inadequate apparatus of research, largely a chimaera, indiscriminate faith in which is akin to that in the stories told in the *Physiologus* and its successors the mediaeval bestiaries about such animals as the elephant and the leopard. These stories were not written in the interests of material truth, but with a strictly moral or religious aim. They completely ignored facts, while claiming to be based on them. It was not until considerable numbers of people went into the countries in which the libelled animals led their own unmoral lives that the true facts became apparent, and I do not think that either the morals of Europe or the interests of zoology suffered in the revelation.

In his *History of English Literature from the Beginning to the Norman Conquest* Stopford Brooke translates an account of the leopard from an early poem on the *Panther, the Whale and the Partridge*. The panther lives, we learn, "In the far lands in deep hollows.............., glittering in a many coloured coat like Joseph's, a friend to all, save to that envenomed scather, the Dragon." After feeding (on what we are not told), he sleeps for three nights. When he awakes, "a lofty, sweet, ringing sound comes from his mouth, and with the song a most delightful steam of sweet-smelling breath, more grateful than all the blooms of herbs and blossoms of the trees." This mystic aroma is compared by the early English poet to the hope of Divine salvation.

However fair the flowers of applied zoology may seem, the ripened fruits are often Dead Sea apples, disappointing as the breath of the leopard, not to mention his unfriendly disposition, must have been to the first lettered Englishman who stumbled upon him in the jungle and awoke him from his slumbers.

Virgil in his *Georgics* wrote what was accepted for centuries by the learned as a manual of practical agriculture poetically expressed. Among other processes he described the manufacture of a swarm of bees from the carcase of a heifer. Imagine the poet reclining in his cool verandah with a manuscript of Thescritus half unrolled on his lap. and pausing in his dictation to gaze over the countryside and muse for a moment on his own love for the simple farmer's life. Fortunately for his reputation as a practical agriculturist his (or father Theocritus's) process for the abiogenetic production of honey-bees, which involved the slaughter of a prime heifer, was as unsound economically as it was biologically impossible. No one tried the experiment, and so the process was accepted from generation to generation as practical. In actual fact the light-hearted, and doubtless illiterate, Samson, who slew a lion on his way to visit his lady-love and afterwards found a comb of wild honey in the skeleton, and made a riddle of it to puzzle the Philistines, was much the more practical man of the two. In modern times the man who introduced mongooses into the West Indies, rabbits into Australia or sparrows into North America doubtless thought that he had accomplished a great work of applied biology—at first.

In discussions on the value of zoological works there is nothing that makes me more indignant than the saying that this or that piece of Indian research is good work—for India. This usually means that it is of inferior quality, but must not be judged too hardly, because it has been done either by an Indian or by an Englishman working amidst Indian difficulties. We Indian zoologists, to judge by the work of our predecessors—Hodgson, Blyth, Stoliczka, Blanford, Alcock and many others—have no reason to claim indulgence. There can be nothing more fatal to Indian science than to aim at a low ideal, and no greater insult can be paid to any branch of scientific effort than to judge it from a racial or a geographical stand-point. Zoology is often regarded in India as the Cinderella of the sciences, and it is, therefore, necessary on occasion for zoologists to mingle the meekness of the dove with the subtlety of the serpent. Some years ago, in my zeal to bring about a certain unity of purpose in the administration of the Indian Museum I incurred the accusation of latent kaiserism from one of my colleagues. I replied that it seemed to me improbable that the youngest and poorest of the scientific departments under the Government of India would arise from the mud like Pharaoh's lean kine and swallow its more prosperous brethren. However effective such replies may be for the moment, the necessity for them does not tend to edification. One branch of science may be poorer in loaves and fishes than another, but all are equal.

Zoology is so closely connected with other branches of biology, and so dependent in the last resort on geology, chemistry and physics, that in my own work I find it frequently necessary to apply to members of other scientific departments for special information. My experience has been that such information is always given in a most ungrudging and generous spirit when applied for personally, but that any official move towards closer co-operation is met with suspicion. I am heterodox enough to believe that the first duty of every scientific department, whether official or otherwise, should be to assist all scientific men in their work, and especially in their research; but to the gods, alas, it has seemed otherwise. The gods of Olympus led a free and joyous life, feasting on nectar and ambrosia: in files and official etiquette the gods of the Himalaya have found more congenial fare. A witty Chairman of the Trustees of the Indian Museum, in which four Imperial survey departments are concerned, once remarked that the chief difficulty in its administration was that the parts were so much greater than the whole. Hypertrophy of the departmental consciousness is a disease to which we heads of scientific departments are by no means immune; a disease, moreover, which the Board of Scientific Advice, despite its zeal in preventing "the overlapping of functions," has failed to cure. In placing zoology on a sound basis in India individual effort alone is of any avail, but the effort though individual must be unselfish, it must not be inspired by any kind of bitterness or self-seeking. We must realize with a sigh that the intelligence of a committee is often much lower than that of its least intelligent member

Even a committee, however, is preferable to individual patronage. I am of the opinion that private donations to science often do more harm than good, not only because of the conditions that usually hedge them round but also because they weaken individual effort in research. Unlike Art, Science abhors patronage and flourishes in hardship and opposition. We are told that in ancient Greece Alexander the Great was the patron of Aristotle, and yet that scientific thought was absolutely free. By the time of Alexander, however, the intellectual light of Greece was fading out, and democracy, the most official form of Government known to mankind, had already found its supreme victim in Socrates, the philosopher whose test for all things was truth. At all periods and in all countries of the modern world—whether it be in the dealings of Pope Urban with Galileo or in those of the British Government with scientific men in the early part of the War—ignorant members of the official hierarchy—and even a high official of the most excellent administration may be very ignorant of science—have attempted to treat science much as St. Columba treated the practical experience of St. Oran. The story is told in full in a comparatively late Irish life of Columba and is barely hinted at in more authentic documents. It seems to me, however, to bear in its primitive simplicity the impress of truth. No mere hagiologist would ever have invented such a story. Here is the story. An important religious building was to be erected on the island of Iona and it had been decided that one man must die for the community and become the guardian spirit of the shrine. St. Columba called for volunteers and St. Oran, who is said to have been his brother, offered himself St Oran was accordingly buried alive. After three days St. Columba, apparently overcome with human feeling, caused the grave to be opened. St. Oran opened his eyes and said, "There is no mystery in death and hell is not like what it was said to be." St Columba, doubtless thinking that the corpse was possessed of devil, cried out in alarm, "Earth, earth on the eyes of Oran, lest he blab more!" And so it was done. 'Earth on the eyes of Oran" has become a proverb in Gaelic.

I had recently in London an opportunity of discussing the position of zoology in this country with one of the greatest of living zoologists. He maintained that zoology should not be encouraged in India until India was in a position to do independent work. By independent work he meant research independent of official control Apart from all personal considerations, I was unable to agree with him, for I see no way of fostering zoological research at present in India but through the agency of government It is quite true that no branch of science can be said to be on a sound basis unless it is independent, and that the flame of research must burn feebly so long as it is not fed by the spirit of individuality. Moreover, the age has not yet come in which the true value of the independence of science will be appreciated by the powers that be. Science and officialdom are as antagonistic as the mongoose and the snake. but officialdom in its dangerous form is a matter of the spirit: *abiit in mores.* To confound government with officialdom is unjust. No government that consisted merely of officialdom could exist for a month. I prefer to regard red-tape as the excreta of government. It is unfair to judge any organism by its excreta, nor is it fair to confound the Imperial policy with the wrigglings of some harassed secretary afflicted with a dysentery of notes and minutes and trembling at the name of the Finance Department.

Zoology throughout the world owes a great debt to the Government of India as the only Government that has founded a zoological survey on a basis of pure research. At the present time zoological posts sanctioned in previous years are kept vacant in Great Britain in the interests of so-called economy, while in India the Government is at any rate attempting to place zoological research on a sound financial basis. The constitution of the Indian Museum is now, especially in the matter of zoology, much more liberal than that of the British Museum from which it was originally copied. We have, therefore, in India justification for the hope of a brighter age. With faith in our calling and hope in its future we zoologists are in a very strong position.

In the whole course of human history there is nothing that has caused more waste of genius, the rarest and most precious of human possessions, than the opposition of officialdom to the progress of knowledge; but even in our struggle with the spirit of officialdom we must preserve two essential qualities, reason and good humour, and the latter does not exclude a sympathetic understanding of shortcomings, both our own and those of others. The lack of reason in scientific men has done as much harm as the ignorance and stupidity of officials. Charity is not only a virtue but also a very powerful weapon in the cause of science, which is the cause of truth. The Scot's half-reverential pity for the Devil, the great Adversary, but for all that the "puir De'il," has done good work for morality and efficiency The fever of fanaticism is all-powerful in initiative, but in the end produces without fail an antitoxin of officialdom. Science can afford to be magnanimous, and the petty politics of the passing hour need not concern us. Truth is great and will prevail. Whatever may be our political views, whatever our race, or creed, or caste, Pope's words stand true in science :—

> "For Forms of Government let fools contest;
> Whate'r is best administered is best:
> For Modes of Faith let graceless zealots fight;
> His can't be wrong whose life is in the right:
> In Faith and Hope the World will disagree
> But all Mankind's concern is Charity"

Pearl production in the Indian pearl oyster—*By* J. HORNELL.

This paper embodies the results of twenty years' acquaintance with pearl oyster research; it sums up the definite conclusions at which the author has arrived.

Pearls are more or less rounded masses of shell substance made up of concentric layers around a nucleus. Any of the four shell layers (including the periostracum) may be present, but true gem-pearls are nacreous. The latter occur almost entirely in the mantle beyond the pallial line. The best are cyst-pearls which arise from a saccate invagination of the mantle epithelium enclosing some irritating object. Cyst-pearls are of two kinds, those that are induced by the presence and irritation of some foreign body, usually a *dead* cestode larva, a grain of sand or other intrusive particle, and those that have a nucleus of periostracal-like substance derived from the oyster's own tissues. The former class, according to the author's investigations, comprises the majority of the larger cyst-pearls,—the true gem-pearls—the latter of the smaller ones of this description, which constitute by far the larger proposition, of cyst-pearls. This conclusion places the cyst theory of pearl origin in its proper perspective; we see that cestode larvae though less frequently the cause of pearl formation than was at first believed, are nevertheless *the most important factor in the production of the larger and finer Orient pearls* and therefore of supreme importance from the economic and commercial standpoint.

The process of pearl formation in the case of these two kinds of cyst-pearls and also in that of muscle pearls are detailed as deduced from experimental work on this subject.

Muscle pearls are those that form invariably close to the insertion of the pallial and other muscles attached to the shell; from the columnar nature of their pseudo-nuclei, we infer that their initial origin is due to the dislodgement of a tiny particle of hypostracum from the surface of the shell at the place where one of the muscles is inserted. This appears to be the consequence of some exceptional strain being set up, due to an excessive and sudden contraction of the muscle involved. Muscle pearls occur frequently in 'nests' containing dozens of these minute hypostracal pearls; as they increase in size, they are very liable to coalesce and form irregular compound pearls. Usually only one layer of hypostracum is laid down, the succeeding layers being composed of nacre. A periostracal layer is not usually laid down around the original nucleus as is the case in cyst-pearls caused by the irritation of an intrusive foreign body.

Notes on the Genera *Bullinus* and *Physa* in the Mediterranean Basin (Mollusca Pulmonata).—*By* N. ANNANDALE.

Notes are given on the appearance and external structure of *Bullinus truncatus* and of *Physa semiopaca* and *P. acuta* as observed in the south of France, Algeria and Egypt. A comparative table of the main differences which can be observed in the living animals of *Physa* and *Bullinus* is added, specially stress being placed on the existence of red blood in the latter and its absence in the former.

On the Phylogeny of some Turbinellidae—*By* E. VREDENBURG.

Slight though well-defined modifications characterising successive geological stages are particularly distinct amongst certain series of fossil Turbinellidae occurring in the Tertiary beds of India. A particularly complete series is afforded by the successive forms *Turbinella episoma*, *T. affinis*, *T. praemekranica* and *T. mekranica*, respectively characterising the oligocene, lower, middle and upper miocene of western India. The resemblance between successive terms is so close as to cause hesitation whether two consecutive forms should be mutually treated as varietally or specifically different; but if one of the terms be omitted, the differences assume a specific value. This particular series is extinct along the coasts of Peninsular India. The living *T. pirum* belongs to a separate branch of foreign origin.

Amongst the Turbinellidae, the Indian Tertiary has also yielded ancestral forms of *Melongena pugilina*, *M. paradisiaca* and *M. melongena*.

Résumé of Recent Progress in our Knowledge of the Indian Wasps and Bees.—*By* CEDRIC DOVER.

A brief review of recent work on the Aculeates, and an appeal to the Editors of the "Fauna of British India" series for a new edition of Bingham's first volume on the Hymenoptera, the Mymarides are also briefly discussed.

The Development of the Ovary of *Culex*.—*By* V. NATH.

When the female culex emerges out of the pupa its ovary has already reached an advanced stage of development. The ground tissue is made up of cells and fibres mixed with a very large number of tracheae. The ovary is bounded by a limiting membrane and has also a lumen. A large number of follicles lie in tubes which rupture when the follicles grow.

The outer boundary of a follicle is syncitial. This syncitium may be called the follicle layer. The content cells of the follicles are all similar in young ovaries. Each has got a prominent nucleus with a single compact karyosome.

Unless the mosquitoes are fed on blood, development stops at this stage. If fed on blood development proceeds rapidly in the following way:—

One content cell of the follicle does not change, that is, it retains the single compact karyosome. This is the future ovum. The nuclei of other content cells become much bigger and their karyosomes break up into a large number of chromatin grains. These are the nurse cells destined to feed the future ovum. Later the outer boundaries of all the content cells unite and there is now a single sheet of protoplasm containing the nucleus of the future ovum as well as the nuclei of the nurse cells. Gradually the nurse cell nuclei also disappear. In other words the nurse cells and their nuclei lose their individual identity and add to the cytoplasm of the ovum. Prominent round grains of yolk now appear in the cytoplasm along with smaller deeply staining grains.

The follicle layer passing through important changes gives rise to the chorion which is made up of a large number of grains of some very hard matter. The chorion is absent at one pole of the ovum thus forming the micropyle. Within the chorion is the delicate vitelline membrane secreted by the ovum.

Copulation is not essential for the development of the ovary. What is essential is feeding on blood.

It seems likely that maturation and fertilisation take place in the oviduct since the spermathecae open into it but by the time the ova reach the oviduct the chorion becomes so hard that it has not yet been possible to obtain sections of the ova good enough to afford the study of fertilisation and maturation.

The Larva of Anopheles annandalei Prashad.—*By* M. O. TIRUNARAYANA IYENGAR.

The original description of the species (in the Records of the Indian Museum, Vol. XV, 1918) is not sufficient for purposes of identification. The larva has therefore been redescribed. It is in many ways very peculiar. Its chief characteristics are the shape of the clypeal hairs, presence of a pinnate "basal hair" of antenna, the shoulder-hairs the external of which as trifid, presence of short curved setae on the thorax and abdomen and the occurrence of long branched hairs on segments 1—6 of the abdomen. It breeds in holes in trees and has been recorded from the Eastern Himalayas.

A Further Note on the Contractile Anterior Thoracic Appendages in Anopheline Larvae.—*By* M. O. TIRUNARAYANA IYENGAR.

In this paper the author has given an account of the internal morphology of the thoracic appendages as revealed by microtome sections in different planes. An account of the previous work on the external morphology, movements and contraction of these paired appendages appeared in the Report of the Proceedings of the Fourth Entomological meeting, Pusa, 1921 (pp 216–217). The structure of the entire appendage is now fully known. But nothing is as yet known about the homology or function of these organs.

Preliminary note on the presence of yeasts in some Homoptera.—*By* M. J. NARASIMHAN.

The author observed in 1916 the presence of large numbers of yeast-cells in smears of crushed insects belonging to the homopterous families *Fulgoridae, Aphidae and Coccidae.* He has since ascertained that the yeasts occur inside the tissues of these insects either scattered or in groups as shown in microtome section. So far as he has observed he has observed them only in insects which secrete the honey-dew. The universal occurrence of the yeasts in these honey-secreting insects leads one to infer that they are probably in symbiotic relation with each other. Two or three distinct forms of yeast appear to occur in different insects.

Isopoda of the family Bopyridae parasitic on the Indian Decapoda Natantia.—*By* B. CHOPRA.

Nothing has so far been published about the Bopyrid Isopoda of the Indian Empire, and very little about those of the neighbouring parts. A considerable amount of work has, however, been done on European and American forms by several workers. So far as strictly Oriental forms are concerned, the islands of the Malay Archipelago have received the most attention, though a number of forms have been described from the seas around Japan.

The family is represented by thirty-one species and twelve genera in the collection of the Indian Museum. Of the twelve genera two are found to be new, while the species with three or four exceptions are also new.

On the occurrence and significance of a third contractile vacuole in *Paramoecium caudatum.*—*By* G. S. THAPAR *and* S. S. CHOUDHURY.

Ordinarily *P. caudatum* contains only two contractile vacuoles. We found a few specimens in our laboratory with three contractile vacuoles. Although similar cases have been previously recorded by some observers, no explanation has been given of this abnormality. The authors after giving a brief summary of the available experimental data regarding the probable functions of this organ discuss the tentative view that the third contractile vacuole is an adaptive development under conflicting internal physiological and external environmental conditions of the animal.

Notes on fresh-water Ciliate Protozoa of India.—*By* B. L. BHATIA.

I. Previous work on the group briefly referred to. Carter had worked in Bombay and Grant and Simmon in Calcutta, but the total number of species of Ciliates recorded from any part of India till 1893, as enumerated by Schewiakoff, was only 16.

II. Record of observation of the writer on 10 species not recorded from India before, viz. *Prorodon edentatus*, *Coleps kenti*, sp. nov., *Coleps uncinauts*, *Didinium balbiani*, *Dileptus gigas*. *Chilodon steini*, *Cyclidium glaucoma*, *Bursaria truncatella*, *Stentor polymorphus*, and *Stylonichia pustulata*.

III. General Summary. As the result of the work of the author previously published or now being communicated, the number of species recorded from India has been considerably augmented. Total number up to date recorded by other observers is 30, those observed by the writer are 41, only two of which had been reported by previous workers. Thus the total record is of 69 species belonging to 46 different genera, and almost all important families are represented.

Forms new to science are an extraordinarily small percentage of the total number investigated. This is in conformity with the well established fact that the fresh-water protozoa are cosmopolitan in their distribution, as also due to a desire on the part of the writer not to base new species on minor structural differences. A more extended survey of these forms from different parts of India would be desirable.

The Modifications of the Swim-bladder in Hill-stream Fishes.—*By* SUNDER LAL HORA.

The swim-bladder of fishes is supposed to be a hydrostatic organ. Fishes living in rapid waters lead a ground habit of life and, therefore, do not need such a baloon-like structure. Consequently the bladder is reduced and it has been observed by studying this organ in several Cyprinoid genera such as *Labeo*, *Psilorhynchus*, *Adiposia*, *Nemachilus*, *Balitora*, *Botia* and *Diplophysa*, that the amount of reduction is more or less directly correlated with the rapidity of the flow of water. The bladder in the first five genera shows a continuous retrogressive degeneration, that of *Botia* is of the normal Cyprinoid type except that the anterior chamber is partially enclosed in bone, while that found in *Diplophysa* is totally different. In *Diplophysa* there are two bladders, the anterior being divided into two lateral portions, which are enclosed in bone like that of the genus *Nemachilus* and the posterior lying free in the abdominal cavity. In this paper an attempt has been made to discuss the probable causes of the modification of the bladder in hill-stream fishes.

Saprolegnia on Murral Fry (*Ophiocephalus marulius*) in Madhopur Hatcheries and its treatment.—*By* HAMID KHAN.

(*i*) Disease at Madhopur Hatcheries of long standing. Many fish died during the last five years.

(*ii*) Fungus attacked Murral Fry in July 1921. The Fry had been kept in live-cars and fed on sheep's liver.

(*iii*) Live cars were smeared with salt and washed in clear water; 78% reduction in casualities resulted.

(*iv*) Fungus indentified as *Saprolegnia*, sp.

Some observations on the Oral Apparatus of the tadpole of *Megalophrys parva* Boulenger.—*By* SUNDER LAL HORA.

During a recent visit to the Khasi Hills a large number of specimens of the tadpoles of *Megalophrys parva* were obtained in a small stream at Dumpep. They were kept under observations for four to five hours. It

was found that the oral apparatus was capable of acting as a float and this function could be performed both when the funnel was expanded and when it was folded No observations were unfortuntately made on the feeding habits of these tadpoles All the views previously held regarding the function of the funnel have been critically examined and at the end a note on .the histology and musculature of the funnel is added. In the text of the paper, the views of Dr. Annandale on the subject have also been embodied.

Evolution and the Individuality of Cells.—*By* HARIDAS BHATTACHARYYA.

The author discusses the different views held by different authorities as to the structure, nature and individuality of cells.

Section of Botany.

President:—DR. W. DUDGEON.

Presidential Address.

THE BOTANICAL OPPORTUNITY IN INDIA.[1]

It is fitting that from time to time we take stock of our botanical achievements, and attempt to form an estimate of the field of opportunity lying before us. It is especially appropriate at this the first programme of the Indian Botanical Society. I deeply appreciate the honour of standing before you in the capacity of President, and ask your indulgence as I attempt to make such an estimate.

The value of such a survey depends on the skill and insight of the one who makes it. If it is well done it should stand as a record of progress, and should serve to stimulate research in all lines of botany. Such estimates made from time to time may well constitute a record of the progress of botany in India. Whatever value there may be in my remarks is in no small way due to the cooperation of a number of botanists who have given me the benefit of their ideas as to the outstanding problems of Indian botany. It is a pleasure to acknowledge my indebtedness to these friends. Except for their aid I should hardly have had the courage to undertake the task, important though I think it to be.

I believe that such a survey as this is very timely. The country is entering on a new era of political, social and educational development. Our scientific activity must be stimulated to keep pace with progress along other lines, and with the science of the rest of the world. India has a heritage of love for learning that we all should strive to maintain. Our field for botanical investigation is almost unlimited. In addition to the perhaps 17,500 species of flowering plants, there is a great assemblage of cryptogams, providing an almost endless variety of material for research in every phase of botany. The peculiar climatic conditions under which our vegetation occurs only enlarge and extend the opportunity for study.

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[1] **Presidential address before the joint meeting of the Botany Section of the Indian Science Congress and the Indian Botanical Society, Madras, February 3, 1922.**

My purpose in this address is to call brief attention to what has been done along certain lines both in India and elsewhere; to point out the great need for research; to indicate some of the lines of study that seem most urgent and most likely to yield results; and to urge an increasing number of young men to engage in more, more intensive, and more effective investigation. To some of my older hearers my remarks may seem presumptuous. They know already the problems of botany, and are actively engaged in research. It is however, to the younger generation that I want particularly to speak. There are many young men who have recently completed their courses of study, obtained their degrees, and entered into their various fields of life work They are widely scattered, and must in a very real sense provide their own scientific inspiration. When we remember that not only the system, but the curriculum, the text-books, the language, and to a large extent the point of view of our education is foreign; that all too much emphasis is laid on the passing of examinations and obtaining of degrees; and that there is a minimum of incentive to continue study and research after the degree is obtained, we must conclude that these men need all the encouragement we can give them. Too frequently they gradually become satisfied with their original preparation, the desire for further progress grows dim, and they settle down to lives of quiet unproductivity. If some can find in what I shall say an incentive to further study and research, I shall feel that my efforts have been successful.

Research in botany means painstaking investigation of plant material to discover new facts to add to the world's stock of knowledge of plants and how they behave. The results of investigation may be put to use at once, or they may have no known immediate utility. We are accustomed to think of the latter as "pure botany." Nowadays it is often only "applied botany" that engages the attention of the professional botanist, and attracts the interest of the layman. We are prone in this hurrying age to demand that scientific work yield immediate and profitable results. There is danger of forgetting that lying back of applied botany there must be an ever enlarging fund of fundamental botanical knowledge to apply. Even though it is not quite so popular and spectacular, we must maintain a large place in our programme for the prosecution of researches into the more fundamental nature and work of plants, without regard to the immediate utility of the results. Above all, we must learn "to regard satisfaction with what has been done as the cardinal sin."

In working out the details of this address, I have been guided by the general principles that it is mainly young men who are in need of guidance, and that it is the most obvious and easily solved problems that will first attract them. There is a wealth of problems in our vegetation fulfilling these requirements. There are many problems of greatest interest and importance that can be most successfully undertaken in India, and some of them will have to be undertaken here if they are to be solved soon or in any adequate manner.

On the other hand there are types and groups of problems that demand of the investigator long thorough training, elaborate facilities, and perhaps most important of all, the stimulus of frequent or constant contact with others working and thinking along similar lines. Such problems can best be undertaken only at the great research centers, mainly in the West. For this reason I shall to a large extent exclude from consideration cytology, considerable portions of physiology and genetics, and extensive monographic work in taxonomy. Various limiting factors—lack of leisure time for uninterrupted application, lack of material equipment, museums and herbariums, adequate library facilities, guidance, and perhaps most important of all, lack of inspiration—combine to make work in these fields difficult or impossible. In this connection it is legitimate to urge on those in authority the necessity for making provision in the various universities and research institutes for the prosecution of such studies.

I want to consider the opportunities for research under the following heads :—

1. Taxonomy of Indian groups.
2. General morphology and anatomy.
3. Physiology in some of its more general applications.
4. Ecology.
5. Genetics in relation to agriculture.
6. Plant pathology.
7. Palaeobotany.
8. Utilization of plant resources.
9. Educational aspects of botany.

TAXONOMY.

Most of the taxonomic work on the vegetation of India has been on the vascular plants. The pioneers of Indian botany—**Hooker**, **Clarke**, **Griffiths**, **Wallich**, and others—were mainly taxonomists, and their extensive exploration and indefatigable collection have made known the bulk of the vascular flora. It is unfortunate for Indian botany that their collections have been to a large extent deposited in European herbariums. Thanks to them and to their successors, we have excellent floras for the whole of the country, as Hooker's[1] monumental work, the Flora of British India, Brandis'[2] Indian Trees, Prain's[3] Bengal Plants, Cooke's[4] Flora of Bombay, Bamber's[5] Plants of the Panjab, Gamble's[6] Flora of Madras, Duthie's[7] Flora of the Upper Gangetic Plain, and Beddome's[8] Ferns of British India.

There is at the present time considerable activity in taxonomic work. Manuals are being prepared for more restricted areas and of more restricted material, as Parker's[9] Forest Flora of the Panjab, Fyson's[10] Flora of the Nilgiri and Pulney Hill Tops, and Ranga Achariar's[11] South Indian Grasses. There are many monographic studies of orders, families, and genera, and studies and descriptions of new species.

Taxonomic works require revision as new species are added to the known flora, and as increasing knowledge changes our conceptions of relationships Such work must be more and more based on extensive observations in the field, and in many cases on analyses of hybrids and species complexes under experimental conditions. We cannot hope to arrive at stable taxonomy till we have greatly increased knowledge of our plant material. It is obvious that such studies can be carried out best in India.

While a vast amount of work has been done with vascular plants, there remains much more to be done with the lower cryptogams. Studies on the occurrence, distribution, abundance and time of appearance of freshwater and marine algae, fungi, lichens, liverworts, and mosses ought to be made, and the results finally incorporated into handbooks with illustrations and workable keys, so that the rank and file of botanists throughout the country could use them. This is undoubtedly a large and monotonous task. It may first necessitate the sending of collections abroad for identification. A fungus flora of India is reported to be in preparation,[1] but it will of necessity be incomplete, for "the total number of recorded species is probably under 2000, which is certainly not one-fourth of those that exist" (p. 65) in the country. In the end we should have works on Indian cryptogams of such a type as WEST's[2] British Freshwater Algae

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[1] Hooker, J. D. Flora of British India. 7 vols. London, 1875–1897.

[2] Brandis, D. Indian Trees. London, 1907.

[3] Prain, D Bengal Plants. 2 vols. Calcutta, 1903.

[4] Cooke, T. The Flora of the Presidency of Bombay. 2 vols. London, 1901–1908.

[5] Bamber, C. J. Plants of the Panjab. Lahore, 1916.

[6] Gamble, J. S. Flora of the Presidency of Madras. 2 pts. London and Calcutta, 1915–1918.

[7] Duthie, J. F. Flora of the Upper Gangetic Plain. 3 vols Calcutta, 1903.

[8] Beddome, R. H. Handbook to the Ferns of British India. Calcutta, 1883.

[9] Parker, R. N. A Forest Flora of the Panjab. Lahore, 1918.

[10] Fyson, P. F. Flora of the Nilgiri and Pulney Hill Tops. 3 vols. Madras, 1915–1921.

[illegible]nga Achariar, K. Handbook of Some South Indian Grasses.

and work [illegible]

Cultivated plants have not received and are not now receiving the attention they deserve. The classification of cultivated plants is rendered difficult by the large and increasing number of varieties. There appears to be a great deal of confusion and error in the application of varietal names BALL[3] says that "some years ago the writer saw at one of the largest agricultural experiment stations in the United States a long series of plots of cereal varieties of which less than 50 per cent were under the right varietal names. Of what value will be the published results, if the varietal names are wrongly applied ? Ten years ago, in his address as retiring president of the Botanical Society of Washington, PIPER recorded his belief that fully 50 per cent of the crop varieties published upon in varietal experiments were either untrue to name or unidentifiable. But how shall they become identifiable without adequate description and classification ? And how shall they become adequately described and classified without botanists to study them ?" Such classification is just as urgently needed in India, before the improvement of crop plants can be put on a firm scientific footing. Taxonomists should not regard the classification of cultivated plants as outside the domains of legitimate botany. Not only is such work greatly needed, but it can be done best by thoroughly trained botanists.

MORPHOLOGY AND ANATOMY.

Throughout the range of Indian vegetation there is a vast amount of material awaiting morphological investigation. Doubtless many of the little plants growing about the doors of our laboratories hold facts of greatest interest. The common practice of bringing our materials for study from a distance is a confession of expediency—of making use of material known beforehand to be fruitful, rather than searching through. what is close at hand. Prof. BOSE in his paper on Bengal Polyporaceae read at this meeting suggests the point I want to make, that so much of our vegetation is as yet so little known that we almost of necessity must ignore it.

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[1] BUTLER, E. J Report of the Imperial Mycologist. Sci. Repts Agric. Res Inst., Pusa 1919-20 : 58-67. 1920.

[2] WEST, G. S. British Freshwater Algae. Cambridge, 1904.

[3] BALL, CARLETON R. The relation of crop-plant botany to human welfare. Amer. Jour. Bot. 3 : 323-338. 1921.

Considering the vegetation by groups, the algae first claim our attention. Here little work has been done, even in a taxonomic way. In addition to a few older scattered references, **Ghose**[1] has recently given us some information about the Cyanophyceae of Lahore, and **Iyengar**[2] has worked out some of the Volvocaceae of Madras. The life histories of algae in a tropical periodic climate—methods of growth, reproduction and perennation—would certainly repay work.

Practically nothing has been done with the morphology of Indian fungi, except in parasitic forms investigated at the agricultural and forest research institutes. The name of **Butler** stands out conspicuously here. But only a good beginning has been made. It is almost essential to know the complete life-history of a parasitic fungus before remedial measures can be intelligently applied. As in the case of algae, there is a very large field for research in the structure and life histories of the as yet little known fungus flora of the country.

Bryophytes are almost equally untouched. **Kashyap** in a series of papers has given us valuable information on the morphology and life-history of several species of liverworts, but there remain a large number that ought to be investigated. There are several species on the Plains, and a treasury of them in the rain forests and the Himalayas. **Kashyap**[3] has already been able to make use of the material he has investigated in a fresh study of relationships. Further study may reveal striking and unexpected results for the elucidation of relationships and the phylogeny of primitive land plants.

I know of nothing that has been done with the morphology of Indian mosses. It is usually considered that mosses as a whole are quite uniform in structure, but until work has been done on the Indian forms, it cannot be said that they would not repay investigation.

Pteridophyte morphology may be expected to yield valuable results. **Kashyap**[4] has made a distinct contribution to our knowledge of *Equisetum* in his investigation of the gametophyte of *E. debile.* Miss **Bancroft**[5] has studied the formation of perennating tubers in two species of *Selaginella* from the Himalayas, and some work has been done on the vascular anatomy of Indian ferns. Probably the greatest opportunity, and the work that most needs doing in pteridophytes, is careful anatomical studies of sporophyte ontogeny. Campbell[1] has shown that the stelar structures of the axis in Ophioglossales are built up exclusively of leaf traces, and suggests that the same situation may be found to obtain in the leptosporangiate ferns. Our large fern flora provides extensive material for this kind of work. If there is any truth in the concept of recapitulation, such studies should throw a flood of light on the relationships, and possibly on the phylogeny of the various groups.

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[1] Ghose, S. L. The Myxophyceae of Lahore. Jour. Indian Bot. 1 : 8–13. 1919.

[2] Iyengar, M. O. Parthasarathy. Observations on the Volvocaceae of Madras. Jour. Indian Bot. 1 : 330–336. 1920.

[3] Kashyap, Shiv Ram. The relations of liverworts, especially in the light of some recently discovered Himalayan forms. Proc. Asiatic Soc Bengal, N.S. 15 : 152–196. 1919. (Presidential address before the Botany Section, Bombay meeting of the Indian Science Congress.)

[4] Kashyap, Shiv Ram. The structure and development of the prothallus of *Equisetum debile.* Ann. Bot. **28** : 163-181. 1914.

[5] Bancroft, N. Note on vegetative reproduction in some Indian *Selaginellas.* Ann. Bot. 28 : 685-693. 1914.

Gymnosperms in general have received much attention. Little, however, seems to have been done with Indian forms. Sethi of Lahore is working on *Pinus longifolia,* where the situation appears to be the usual one for *Pinus*, and Saxton of Ahmedabad is undertaking *Cedrus deodara.* It is likely that the study of life-histories of Indian gymnosperms will add little that is new to our knowledge, except possibly in the Gnetales. *Gnetum gnemon* and *G. scandens* have been investigated, but it appears that there still are species *Gnetum* in Burma and the Malay Peninsula, and of *Ephedra* in the Himalayas that have received no attention. Because of the unique character of the Gnetales, these unknown forms should be looked into. Collections for morphological purposes should be made whenever opportunity offers.

The vascular anatomy of all Indian gymnosperms should prove interesting. Groom and Rushton[2] have investigated the wood of Himalayan species of *Pinus.* Comparison of the structure of ordinary and spur shoots of Himalayan conifers, and the anatomy of unworked Gnetales are further problems.

Since the overwhelming majority of Indian vascular plants are angiosperms, they present a large field for research. Almost no morphological or anatomical work has been done on them. Sabnis[3] has done considerable work on the anatomy of the plants of the Indian desert. Almost any species should provide a starting point for morphological work, and we should have information regarding Indian species made available. It is rather unlikely that many angiosperms will show anything unusual; but a few species may reveal situations that will make a distinct advance in our knowledge. For example, a casual examination of *Ophiopogon intermedius* Don of temperate mountain areas of India shows in microsporogenesis 56 bivalent chromosomes so distinct that they can be counted under an ordinary high power without any treatment whatever Many important results have come out of the study of ordinary material. Double fertilization, by NAWASCHIN[1]? oogamous apogamy, by JUEL,[2] and an embryo sac of four megaspore nuclei, by DAHLGREN[3] may be cited as examples. It may be that embryo sacs will be found that will give a definite clue to the origin of the embryo sac, though SCOTT's recent statement[4] that "It is safer to regard the Pteridosperms, and therefore the Seed Plants generally, as a distinct stock, probably as ancient as any of the recognised phyla of Vascular Cryptogams" (p. 391), assigns to the angiosperms such great antiquity that the expectation is minimized.

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[1] Campbell, D. H. The eusporangiate ferns and the stelar theory. Amer. Jour. Bot. 8 : 303–314. 1921.

[2] Groom, Percy *and* W. Rushton. Structure of the wood of East Indian species of *Pinun.* Jour. Linn. Soc. Bot. 41 : 457–490. 1913.

[3] Sabnis, T. S. The physiological anatomy of the plants of the Indian desert. Jour. Indian Bot. 1 : 33–53, 65–83, 97–114, 183–205, 237–247, 277–295, 2 : 1–20, 61–79, 93–115, 157–173, 217–235, 271-299. 1919–21.

It seems quite possible that degeneration during mega and microsporogenesis as I was able to trace it in *Rumex crispus*[5] may be found to be of widespread occurrence. It may be found to give a clue to the morphological origin of dicliny, to offer an explanation of sex intergrades, and to contribute to the solution of the problem of sexuality in plants. There is abundant material in our flora for the study of this problem.

Comparative anatomy has been used with conspicuous success in unraveling the relationships among fossil plants. JEFFREY[6] has formulated certain "canons of comparative anatomy" and applied them to living plants with equal success. Comparative morphology and anatomy will be of increasing service to taxonomy in indicating relationships. Our flora presents a rich field for such investigation. BECHTEL's[7] work on the floral anatomy of the Urticales is a recent example of the results that may come from such studies

Indian plants have received altogether too little attention from morphologists, and the conclusion is that a whole host of these plants should have their morphology and vascular anatomy investigated.

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[1] NAWASCHIN, S. Resultate einer Revision der Befruchtungsvorgange bei *Lilium Martagon* and *Fritillaria tenella*. Bull. Acad. Imp. Sci. St. Petersbourgh **9**: 377–382. 1898.

[2] JUEL, H. O. Pathenogenesis bei *Antennaria lapina* (L.) R. Br. Bot Centralbl **74**: 369–372, 1898.

[3] DAHLGREN, K. V. OSSIAN. Dar Embnyosack von *Plumbagella*, ein neuer Typus unter den Angiospermen. Arkiv f. Botanik **14**: 1–10. 1915.

[4] SCOTT, D. H. The present position of the theory of descent, in relation to the early history of plants. Chem. News **123**: 289–293, 301–304. 1921.

[5] DUDGEON, WINFIELD. Morphology of *Rumex crispus*. Bot. Gaz. **66**: 393–4.0. 1918.

[6] JEFFREY, E. C. The Anatomy of Woody Plants. Chicago, 1917.

[7] BECHTEL, A. R. The floral anatomy of the Urticales Amer. Jour. Bot. **8**: 386–410. 1921.

PHYSIOLOGY.

Perhaps physiology is after all the most fundamental of the botanical sciences, and it has been making rapid progress in the last few years. Chemistry and Physics are becoming such important parts of physiology that the average botanist has difficulty in keeping up with the procession. Much of the present trend of the subject requires such a mastery of chemistry and physics, such elaborate equipment, and to such a large extent the stimulus of contact with others interested in and engaged in similar research that really fundamental investigations in physiology are difficult in India. Some of the most valuable and suggestive aspects of physiology, as osmotic pressures of sap, permeability, antagonism, the chemistry and physics of protoplasm, enzyms, photosynthesis, and metabolism are accordingly excluded from this discussion

Physiology as such has scarcely been touched in India. HOWARD[1] and HOLE[2] have done valuable work on the effect of soil aeration on the growth of plants of economic importance, and J. C. BOSE has made valuable contributions on the response of plants to stimuli, and on refined methods of studying response

There is however a vast amount of work that can be done without the necessity of highly specialized training and elaborate outlay on equipment The work of JIVANNA RAO[3] on the conditions of leaf-bladder formation in *Eichornia* is an illustration. Some of the problems that seem most approachable and that would yield exceedingly valuable results are:

1. The water relations and demands of plants.
2. The light relations and demands of plants.
3. Temperature requirements of plants.
4. Soil fertility studies.

Water relations.—Conditions over the greater part of India are suitable for the growth of plants throughout the year. except as water is a limiting factor. Periodicity in precipitation is a marked feature of the climate We need exact data on the evaporating power of the air throughout the year, and the response of plants to the actual fluctuations in humidity, and to the variations in water available to the roots. The evaporimeter devised by BATES[4] gives records of evaporation closely paralleling the transpiration of plants exposed to similar conditions, with plenty of water available. In nature, however, maximum transpiration occurs during the dry season, when available soil moisture is at a minimum. Many of our common crop and characteristic wild plants should be studied with regard to their water demands. It is probable that the results would be of great value to agriculture, especially in connection with the search for varieties suitable for growing in the various parts of the country.

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[1] HOWARD, A. Recent investigations on soil aeration Pt. I. With special reference to Agriculture. Agric. Jour. India **13** : 416-429. 1918.

[2] HOLE, R. S. Recent investigations on soil aeration. Pt. II. With special reference to forests Agric. Jour. India **13** : 430-440 1918

[3] JIVANNA RAO, P. S. The formation of leaf-bladders in *Eichornia speciosa* Kunth (water hyacinth) Jour Indian Bot. **1** : 219-225. 1920.

[4] BATES, C. G A new evaporimeter for use in forest studies. Monthly Weather Rev. **47** : 283-294. 1919.

Light relations.—GARNER AND ALLARD[1] have shown that the number of hours of daily illumination is one of the most important factors in regulating the vegetative and reproductive phases of plants. They find in the species they have studied that "normally the plant can attain the flowering and fruiting stages only when the length of day falls within certain limits, and, consequently, these stages of development ordinarily are reached only during certain seasons of the year. In this particular, some species and varieties respond to relatively long days, while others respond to short days, and still others are capable of responding to all lengths of the day which prevail in the latitude of Washington where the tests were made" (p. 603). This opens up a wide new field for experimental work. It is entirely likely that the failure of certain crop plants in India and the tropics generally, and the conspicuous success of others may be due in large part to their differing light demands. We cannot regulate the period of daily illumination under field conditions; but we can take advantage of varying lengths of day throughout the year, and we can make use of varieties whose light demands coincide most exactly with the actual daylight period. It is possible that the success of certain elementary species and hybrids over others depends on their ability to make effective use of the light of tropical days. This factor may well be taken into account in the development and selection of new varieties for different parts of the country. The problem is one that surely would repay study.

Temperature requirements.—In the temperature relations of plants WALSTER[2] concludes that there is a correlation between the temperature of germination and nutrition effects. It is found that for cereals especially, a lower temperature during germination, followed by a higher temperature during subsequent growth gives maximum yield. Plants germinated at higher temperatures, especially in the presence of a plentiful supply of nitrogen, may be maintained in the vegetative phase almost indefinitely. This, in connection with the light effects already mentioned, probably explains the failure of temperate region plants in the tropics, and the success of tropical plants. It would be worth while to have extensive experiments along this line.

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[1] GARNER, W. W. *and* H. A. ALLARD. The effect of relative length of day and night and other factors on growth and reproduction in plants. Jour. Agric. Res. 18 : 553–606. 1920.

[2] WALSTER, H. L. Formative effect of high and low temperatures upon growth of barley: a critical correlation. Bot. Gaz. 69 : 97–126. 1920.

The factors involved in the acclimatisation of plants from other parts of the world is a problem that would repay study. As never before, there is an interchange of plants throughout the world, and some of our most valuable plants are introduced. Just what would need to be done in such work, and what results to expect, would be difficult to say; but undoubtedly there is need for such study, and the results might be of far-reaching importance for the agriculture and horticulture of the country.

Soil fertility offers another immense field for research, involving as it does both the micro-organisms of the soil, and the plants grown in this soil. The problem of soil fertility has long engaged the attention of agriculturists, and such studies have gradually settled down along certain traditional lines—permanent plots, soil tanks, and pot cultures. However, there is coming to be a growing dissatifaction with the results obtained by such methods. LIPMAN AND LINHART [1] and SEBELIEN [2] have recently concluded that the results obtained from ordinary plots are of such little practical value that they do not justify the time, energy, and money expended on them. Pot culture methods yield results of great physiological value, but leave many problems unsolved It looks as if we would have to have a great advance in knowledge of plant physiology before we can solve the problems of soil fertility.

THOMPSTONE [3] believes that the practice of burning hill jungles and cultivating the cleared area for only two or three years derives its advantage from the killing by heat of bacteria-destroying protozoa in the soil. We need extensive studies of the micro-organisms present in the various soils of the country, their occurrence, abundance. seasonal variation, and physiological action.

On the other hand the reaction of plants to the various factors of soil fertility needs a vast amount of work. Much has been done already. But we should be prepared for striking results in increase of plant production in the future.

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[1] LIPMAN, C B. *and* G. A. LINHART. A critical study of fertilizer experiments. Proc. Nation. Acad. Sci. (U.S.) 6 : 634–686. 1920.

[2] SEBELIEN, JOHN. Modern methods for experiments with fertilizers and manures. Jour. Agric. Sci. 10 : 415-419. 1920.

[3] THOMPSTONE, E. Agriculture in the Shan States. Agric. Jour. India. 1921.

HARRISON[1] in reporting on manurial experiments on rice at Pusa states that "in a few isolated pots (about 6 per cent of the total) a very abnormal growth took place, varying from 200–500 per cent increase over the check pots in their particular series." and "other officers in the department have had similar experience' (p. 43). The cause of this unusual growth remains unknown, but the fact indicates the possibility of enormous increase in plant production, when the factors involved are discovered. In this connection, soil aeration, already known to be an important factor in promoting plant growth, should receive much more experimental study

COLEMAN[2] calls attention to the danger of making increased demands on the soil by means of improved varieties of crop plants, without a parallel improvement of the fertility of the soil. The problem therefore is an urgent one. As long as the supply of food is the dominant problem of India, the problem of soil fertility remains a standing challenge to our plant physiologists.

ECOLOGY.

Ecology is not as clearly defined as the other great subdivisions of botany It is still largely an observational science and as it becomes more exact it tends to pass over into morphology and physiology. It is as yet largely a matter of observation and description of vegetation, and the value of the results depends therefore on the critical judgment of the observer.

In recent years there has been great activity in ecology in north temperate regions, and latterly in the south temperate also. But little has been done in the tropics, and almost nothing in a climate such as ours, and in areas of crowded agricultural populations such as are found in India and China. SCHIMPER[3] has worked in Java. and BROWN[4] has made intensive studies in the Philippines There is only a little such comprehensive work of India. HOOKER[5, 6] has described the plant geography, and divided the country into characteristic vegetational areas, giving the distinct floral composition of each. Recently AGHARKAR [1] has extended the details of this work for arid north-west India. BLATTER AND HALLBERG [2] have described the vegetation of the Indian Desert on the basis of WARMING'S [3] formations, and SAXTON AND SEDGWICK [4] have done the same for Gujarat. KENOYER [5] has made a study of successions in the subtropical forests of the middle Himalayas, and I [6] have made a similar type of study of the Gangetic Plains vegetation. HOLE [7] has studied the ecology of grasses in relation to forest types and later [8], has emphasized the importance of ecological studies in solving problems of grazing land and forest management, and in the control of plant diseases Other work is reported at this meeting, and is in progress, and the outlook for ecology in India is bright.

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[1] HARRISON, W H. Report of the Imperial Agricultural Chemist. Sci. Repts Agric. Res. Inst., Pusa 1918–19: 35–45. 1919.

[2] COLEMAN, L. C Indian agricultural development. Jour. and Proc. Asiatic Soc. Bengal, N. S. 14: 102–109. 1918. (Presidential address before the Section Agriculture, Lahore meeting of the Indian Science Congress.)

[3] SCHIMPER, A. F. W. Plant Geography upon a Physiological Basis. English translation. Oxford, 1903.

[4] BROWN, WILLIAM H. Vegetation of Philippine Mountains. Manila, 1919

[5] HOOKER, J. D. Introductory essay in HOOKER *and* THOMSON. Flora Indica, pp. 1–260. London, 1855.

[6] HOOKER, J. D. Chapter Botany, in Vol. I Imperial Gazetteer of India. Oxford, 1907.

The broad principles of ecology have been derived from studies on the vegetation of temperate regions. It is not yet known how generally these principles apply to the tropics. One botanist has put it. " a large part of the plant associations (in India) should be studied without trying to fit them into a European or American system. Much study will be required before we get any clear ideas of Indian ecology as a whole." BROWN [9] expresses a similar doubt : ". . . . botanists from temperate regions are too apt to regard temperate vegetation as a generalized type and tropical vegetation as a specialized one, whereas there certainly are many reasons for considering the reverse as the more nearly correct view " (p. 43) Intensive studies of our tropical and subtropical flora may lead to the necessity of modifying the ecologic concepts derived from temperate regions. Because our vegetation lies in a strongly periodic monsoon climate, and because of the action of the dense agricultural population, ecology offers unique opportunities for investigation. Perhaps it is the most fertile field confronting us just now; and the work does not require either long intensive training, or excessive outlay on material equipment. The most accessible problems fall into three groups :

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[1] AGHARKAR, S. P. Über die Verbreitungsmittel der Xerophyten, Subxerophyten und Halophyten des nordwestlichen Indiens und ihre Herkunft. Inaug. diss. Berlin, pp. 1-41. 1920

[2] BLATTER, E. *and* F. HALLBERG. The flora of the Indian desert. Jour. Bombay Nat. Hist. Soc. **27** : 270-279, 506-519. 1921.

[3] WARMING, EUG. Oecology of Plants. English edition. Oxford, 1907.

[4] SAXTON, W. T. *and* L. J. SEDGWICK. Plants of northern Gujarat. Rec Bot. Surv. India **6** : 205-323. 1918

[5] KENOYER, L. A. Forest formations and successions of the Sat Tal Valley, Kumaon Himalayas. Jour. Indian Bot. **2** : 236-238. 1921.

[6] DUDGEON, WINFIELD. A contribution to the ecology of the Upper Gangetic plain. Jour. Indian Bot. **1** : 296-324. 1920.

[7] HOLE, R. S. On some Indian grasses and their oecology. Indian Forester **1** :

[8] HOLE, R. S Plant oecology and its bearings on problems of economic importance in India. Jour and Proc Asiatic Soc Bengal, N.S. **14** : 156-167 1918. (Presidential address before the Section Botany, Lahore meeting of the Indian Science Congress)

[9] BROWN, WILLIAM H. Vegetation of Philippine Mountains Manila. 1919.

1. Descriptive studies.
2. Response of the vegetation to the periodic climate.
3. Effect of man on the vegetation.

Descriptive studies will work out the great formations of the natural vegetation, and relate them to the climatic factors. This will include a study of the successions leading up to the climax vegetations. As these studies become more exact, they will increasingly require the use of instruments for determining the details of the climatic factors and their influence in determining distinct types of vegetation. We have the meteorological records available, but they give little clue to local deviations of moisture, humidity, insolation, temperature, and exposure to wind, that are so important in causing local differences in vegetation.

Considerable effort has been made in the West toward developing exact statistical methods of describing vegetation. Perhaps the work of RAUNKIAER[1] is best known. Undoubtedly such efforts are still unsatisfactory, but they make it possible to compare directly the vegetations of widely separated areas, and also to distinguish slight differences in local areas. It would be a most valuable contribution to have our various types of vegetation studies by such statistical methods..

The geographic botany of the country has received little attention along modern lines. The work of HOOKER and of AGHARKAR has been mentioned. While the broad affinities of the Indian flora seem pretty well established by the work of HOOKER, we need intensive local studies to determine the rate and method of spread, limiting factors, routes of migration, and sources and antiquity of the vegetation of different areas.

The response of plants to our periodic climate offers an equally fruitful field for detailed studies. There is little botanical activity in similar climates in other parts of the world. The problem of the effect of a monsoon climate on the individual plant is one that offers many points of approach, and that can be undertaken almost anywhere by anyone sufficiently interested.

It is commonly considered that leaf fall is caused by approaching excess of transpiration over water intake. In temperate regions this is brought about by increasing cold slowing down root activity. In India we see small plants losing their larger leaves and tender shoots in response to excessive transpiration, as the dry season advances. Excessive transpiration may also explain why the trees of the Peninsular forests lose their leaves along through the winter and spring, but it offers no explanation of why the new flush of leaves comes out and remains on the trees before the beginning of the monsoon, when conditions are at their severest. This new angle of the problem should be attacked.

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[1] **RAUNKIAER, C. Recherches statisques sur les formations végétales. Kg. Danske Vidensk. Selsk., Biol. Meddelelser 18 : 1–80. 1918.**

Practically nothing that I know of has been done with the distribution of roots and perennating organs in a monsoon climate. Do they behave as the roots of desert plants, as described by CANNON[1], or as the perennating organs described by WARMING[2], and others? This can be answered only by patient study of the occurrence and behaviour of these structures, and the methods of perennation and propagation, especially of the characteristic rainy season and dry season floras.[3] In addition, we should have information as to the time and the organs of storage, and the time and methods of utilization of reserve food materials and water. These problems should yield to histological and microchemical studies.

The anatomical response of plants to the periodic climate is another problem. Work has been done in the West comparing the anatomy of the same species in different habitats, but HANSON[4] has shown that there is equal or greater difference in the leaves from different locations on the same tree than has previously been reported from different habitats. With this caution in mind, it should be possible to make valuable comparative studies on the effect of the three climatic seasons on the anatomy of the vegetative organs.

Change in the aspect and content of the vegetation in relation to the climatic seasons needs investigation. We know in general that a luxuriant mesophytic vegetation of tropical affinities flourishes during the monsoon; a temperate vegetation during the winter; and a relatively small group of persistent xerophytic perennials during the spring; but we should have exact intensive studies, probably largely statistical. Such studies would apply equally to the whole range of cryptogams. It is here especially that taxonomic studies are needed as a basis for further work TRANSEAU's work[1] on periodicity in freshwater algae is an illustration of this type of investigation

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[1] CANNON, W. A. The Root Habits of Desert Plants. Carnegie Institution of Washington Pub. No. 131. 1911.

[2] WARMING, EUG. Om Jordudlbere. Kgl. Danske. Selsk, Skrift, Vaturv. og Mathem. VIII: 2: 297-378. 1918.

[3] DASTUR, R. H. *and* W. T. SEXTON. A new method of vegetative multiplication in *Crotalaria burhia*, Ham. New Phytologist **20**: 228-333. 1921. This paper has appeard since the above was written.

[4] HANSON, H. C. Leaf structure as related to environment. Amer. Jour. Bot. 4: 533-560. 1917.

Effect of man on vegetation.—Heretofore ecology has been concerned mainly with natural vegetation, and the effort has been to find areas that have come as little as possible under the influence of man Such areas are still to be found in the Himalayas and in parts of the Peninsula There has not been much work directly attacking the problem of the nature and extent of the effect of a crowded agricultural population on vegetation. India and China are the two great fields for the study of this problem. Aside from the fact that man destroys the forests and to a large extent the herbaceous vegetation cover, we have little information. BURNS AND CHAKRADEO[2] have begun a detailed study of natural recovery, under protection, of badly overgrazed Deccan pastureland. The various afforestation projects, especially in the United Provinces, should yield valuable information, and ought to be studied at every stage of progress. It seems probable that the present vegetation, especially forests, could be correlated with density of population, in much the same way as BRANDIS[3] has done for rainfall.

A knowledge of the effect of man on the vegetation will not only be of much scientific interest, but will undoubtedly prove to be of greatest practical value in future efforts to develop and conserve the vegetation resources of the country. This type of study is new, and India affords unusually favourable material.

GENETICS.

Genetics has made rapid strides since the rediscovery of MENDEL's classical work in 1900. The subject is so attractive and so filled with possibilities for usefulness that an ever increasing number of botanists is going into it. Fundamental work on the underlying principles, including investigations into the cytological basis of heredity is as yet pretty definitely confined to the great research institutions of the West

We have a statement of the present position of genetics in India by BURNS[4] in his presidential address before the Botany Section at Nagpur. Interest in the subject is evidenced by the large proportion of genetics papers on our present programme. Much valuable work has been done at the various agricultural research institutions on crop plants, especially in segregating pure lines, with the view to finding varieties suitable for particular needs and local conditions. The results will be of increasing use in developing new stable combinations in future breeding experiments. All observers of plants should be constantly on the watch for mutations of all kinds. We have only to recall that the novel orange industry of California arose from a mutation discovered in a single tree in Brazil

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[1] TRANSEAU, E. N. The periodicity of freshwater algae Amer. Jour. Bot. **3** : 121–133. 1916.

[2] BURNS, W. *and* G. M CHAKRADEO. An ecological study of Deccan grassland Jour. Indian Bot. **2** : 84–91. 1921.

[3] BRANDIS, D, On the distribution of forests in India. Ocean Highways 1872 : 88–113. 1872.

[4] BURNS, W. Some aspects of plant genetics. Proc. Seventh Indian Sci. Cong. 1920 : 88-109. 1921. (Presidential address before the Section Botany, Nagpur meeting of the Indian Science Congress.)

It cannot yet be said that the method of evolution has been discovered. But we should remember that the concept of mutation got its great start from DeVries' study of a mere weed. Who shall say that in our vast flora there is not some plant or plants which when carefully studied will yield equally striking results ?

I want to go no further than to emphasize the far-reaching practical importance of genetics to our problems of agriculture, and to urge greater activity in the subject.

Plant Pathology.

Plant pathology is mainly the application of knowledge of parasitic fungi. The importance with which the subject is regarded in the West is indicated by the increasingly large staffs of pathologists connected with agricultural institutions. Considerable work has been done in India, especially in the agricultural research institutes and agricultural departments. Departments of botany in our colleges and universities have as yet made little contribution to the subject. The work of Butler [1] stands as an inspiration to all interested in pathology.

The first task confronting plant pathology in an old country where agriculture has long been established is the investigation of existing diseases. Much has been in India, and much remains to be done, both in working out the life histories of disease producing organisms, and in devising practical methods of control. Until recently the ancient crop plants and their diseases were balanced against each other.. But with changing agricultural conditions—improved strains of indigenous cultivated plants, better methods of cultivation, and the introduction of foreign plants and their diseases—there almost certainly will be serious outbreaks of plant diseases in India. An examination of Butler's book indicates that this process has already begun A considerable number of important diseases have been found in India for the first time only recently. The only way to cope with such a situation is to have a reserve of trained men ready to combat such outbreaks. The point I want specially to emphasize in this connection is the desirability of raising up a body of young pathologists to meet this situation. The pathologist must have a thorough grounding in general botany as well as special training in fungi and physiology. All of us who are in teaching positions where such training may be given have before us the opportunity to help by providing such instruction as will fit students to be efficient pathologists.

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[1] **Butler, E. J. Fungi and Disease in Plants. Calcutta, 1918. Also numerous memoirs.**

PALAEOBOTANY.

Palaeobotany is almost an untouched field in India. Heretofore, work has been done by geologists, partly from purely scientific interest, and partly as a means of comparing geologic horizons. SAHNI[1] has given us a résumé of the present position of Indian palaeobotany, and SEWARD AND SAHNI[2] have recently restudied old collections from the Indian Gondwana beds.

As yet the facilities for the study of palaeobotany are very limited. But such studies are needed, and they should throw much light on the origin and significance of the present vegetation. Knowledge of the character of the plants of the past, and their migrations and distribution, will be of value in interpreting the vegetation of to-day. The address by SCOTT[3] already referred to gives an outline of the present status of our knowledge of ancient land floras, and at the same time emphasizes strikingly how incomplete this knowledge is. There is considerable opportunity in India for investigations in palæobotany.

UTILIZATION OF PLANT RESOURCES.

I have hesitated about introducing this topic, not because there is any lack of need for work, but because it tends to diverge from the usually accepted field of botany. The population of India is dependent to an unusual degree directly on the vegetation for food. Ancient crowded populations tend to become balanced against their food resources, and the supply of food becomes a limiting factor to increase in population. Our natural resources are already very completely utilized, but this utilization is often not only unscientific, but absolutely wasteful. I want to suggest just a few problems, the significance of which will at once be apparent.

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[1] SAHNI, B. Presidential address, as yet unpublished, before the Section Botany, Calcutta meeting of the Indian Science Congress, 1921.

[2] SEWARD, A. C. and B. SAHNI. Indian Gondwana plants, a revision Mem. Geol. Surv. India, N.S. 71 : 1-54. 1920.

[3] SCOTT, D. H. The present position of the theory of descent, in relation to the early history of plants Chem. News **123**: 289-593, 301-304. 1921.

There is a decided deficiency of fats in the dietary of a large part of the population. Popularization and preparation of plant fats and oils is needed to supplement the available animal fats, mainly butter. Development along scientific lines of indigenous wild food plants—roots, tubers, fruits, and seeds—might be of great value in preparing against famine, as a large number of these plants are very hardy and will produce under the most adverse conditions. Exact knowledge of the properties of medicinal plants and their products, their production and preparation, is needed to put the ancient systems of medicine on a modern footing. Various aspects of the forestry industry will bear much more study. The production of gums, resins, rubber, dyes, essential oils, and paper pulp are other problems for research in the field of economic botany.

EDUCATIONAL ASPECTS OF BOTANY.

Our Indian botany is still in its infancy. In the University of Allahabad fewer than one-half of the affiliated colleges teach science ; of these only six include biology, and none offer instruction above the B.Sc. degree. The centers in India providing for advanced training in botany are all too few.

A feature of botanical education that should engage our best attention is the content and purpose of our courses. We should not be satisfied that the traditional content of botany is good enough Our present education is altogether too theoretical. It makes too little contact with the actual problems of the country. I believe we need to put much more emphasis on the practical application of botany, even at the risk of over-emphasis, in the effort to counteract the present tendency. I take it that botany may be taught for its cultural value, for its scientific interest, and to prepare specialists. Whatever the purpose, the value of the teaching depends much less on the specific requirements of the syllabus than on the training and attitude of the teacher ; and it is just here that we can make the greatest improvement in botanical education

In connection with instruction we should have text-books prepared with special reference to Indian needs and conditions, and in the spirit of modern developments in education, to free us from dependence on foreign texts. Professor RANGA ACHARIAR [1] has attempted to do this in his elementary text-book. We need really interesting nature study books for our middle schools, texts for high school grade, and at least one rather advanced text for B.Sc. student. This last might well be written in parts, e.g. taxonomy, morphology, physiology, ecology, genetics, palæobotany, economic botany, pathology, history of botany, and microtechnique, so as to permit the parts to be used in any desired combination.

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[1] RANGA ACHARIAR, K. A Manual of Elementary Botany for India. Madras, 1916.

Another urgent need is for manuals of botany covering restricted natural units of vegetation, so simple as to require little technical knowledge, for the use of beginning students and laymen. Existing manuals presuppose considerable knowledge of botany, and for the most part are too costly for students. The new manuals should be compact enough to be easily carried; should have easy descriptions, and artificial keys as far as necessary to families, genera, and species; should include brief notes on ecological habitats, uses, and other interesting information; and should be cheap enough to be within the buying power of students. Existing larger works would serve as a basis for the compilation of these manuals They would go far toward arousing wider interest in plants.

Another need is accessible knowledge of our vegetation with reference to its actual use in instruction. All of us know certain plants that we make use of for various purposes; it would be an immense help if this scattered information could be gathered together in such a form that all could have the benefit of it.

Research must become an increasingly important feature of our educational system. Research demands time to work, to read, and to ponder. No one overloaded with routine teaching or with administrative work can do justice to his research. At the university centers and at the various research institutes larger staffs are needed: to allow time for research; to give studies, especially postgraduates, the varied and authoritative instruction they need to prepare them for scientific leadership; and to cope with the vast array of problems right now demanding investigation. We should exercise every care to make our teaching inspire an increasing number of young men to choose botany as a profession—men who would become botanists for the love of the game, and not merely because it is an honourable profession. These men must be led up to the firing line of research, and inspired by the example of their teachers engaged in investigation, and then sent out with the charge to be fruitful and multiply knowledge.

Libraries throughout the country are in need of upbuilding. We must constantly emphasize to those in authority that without adequate library facilities a science department is too seriously handicapped to be able to function properly.

Finally, I want to emphasize the need for popular literature on scientific subjects. The average educated man in India knows little about what is going on in the scientific world. He does not know the aims of science, and does not appreciate its utility. If scientists in general were to engage more freely in writing popular scientific articles, it would go a long way toward arousing interest in and sympathy for science and its accomplishments. Think of the value of such literature as LANKESTER's "Science from an Easy Chair." Most probably it would in the end result in greatly increased support for science; and institutions would find it possible to make the development both in personnel and in equipment that we know to be so necessary. Popular writing is difficult, and few have the natural gifts to do it well; but both the need for it and the value of it are great.

What I have had to say has of necessity been of a general nature. Any attempt to develop the problems in more detail, and to suggest lines of attack would extend the address to a wearisome length. The field of botanical opportunity is as extensive as the world of plant life. Solution of the problems presented in the vegetation of India will contribute much to the advance of world science. I am conscious of the many defects in this attempt at estimation of the botanical opportunity in India I can only hope that some may find in it a new inspiration for research, and that the suggestions that have been made may be of some slight use in the selection of problems for investigation. It is my earnest hope that the Indian Botanical Society may increasingly serve in encouraging and furthering research, and that in the years to come it may in very deed be "A society for uniting the botanists and promoting the botanical interests of India."

Contribution to the life-history of *Aneura indica.*—*By* SHIV RAM KASHYAP *and* SHIVA KANT PANDE

Aneura indica is the first Indian species in which the life-history has been worked in any detail. The plants studied were collected from various localities, Dalhousie, Lahore, Chamba-Chuari Road, Nilgiris, etc.

The investigation confirms in a general way the conclusions arrived at by Clapp after her study of *Aneura pinguis* (Bot. Gaz., Sep. 1912). The more important points are summarised below:—

1. The thallus is very variable as regards its habit and especially the shape of the epidermal cells, and its thickness.
2. The plant is dioecious.
3. Usually one antheridium is found in each chamber. Occasionally two are met with.
4. The sperm is a long narrow coiled structure of the usual type The blepharoplast could be made out in some slides during the development of the sperm.
5. The archegonium arises from a single projecting cell, below which two oblique walls can usually be distinguished. The neck contains 3–5 neck-canal cells.
6. In the early stages of the development of the sporogonium the cells immediately below the foot are narrow and a little elongated, resembling to some extent the cells of the elaterophore.
7. Elaters are differentiated very late.
8. There is a well-developed elaterophore.

9. The capsule-wall is only two layers of cells in thickness at the time of the division of the spore mother cells. The calyptra, at this stage, is 4–6 cells in thickness.
10. The number of chromosomes is 12 in the sporophyte and 6 in the gametophyte.

Contributions to the life-history of *Pingus longifolia.*—*By* M. L. SETHI.

The present paper is continuation of a paper which the writer read at the Calcutta Session of the Congress on "The Female Prothallus of *Pinus longifolia.*" After the maturation of the egg nucleus there appears a so called 'Receptive Spot' in the egg cytoplasm just below the neck. The pollen-tube opens into the archegonium by a definite pit and discharges all its contents into the archegonium along with some cytoplasm and starch grains. Only the larger male nucleus takes part in fecundation. The tube-nucleus and the stalk cell soon disorganise in the egg cytoplasm. The first two divisions following fecundation take place very quickly. The four segmentation nuclei pass down to the base of the egg and arrange themselves in one plane. Cross walls are formed in connection with the first division. The vertical walls are also formed at this stage on fibres which arise independently in the cytoplasm. The next division takes place in the upper tier giving a three tiered embryo. The next and the last division takes place in the lowermost tier which completes the development of the proembryo. The suspensor is formed from the second tier from below. This pushes down the embryo-tier into the female prothallus, the starchy contents of whose cells probably serve as a nutriment to the growing embryo.

Note on some attached forms of Zygnemaceae.—*By* M. O. PARTHASARATHY IYENGAR.

Three attached algae belonging to the Zygnemaceae (a *Spirogyra*, a *Zygnema* and a *Mougeotia*) were studied as regards their methods of attachment.

Spirogyra forms a well developed disc-shaped rhizoidal attachment from the end-cell of its filament and also from the sides of other cells of the filament when they come into contact with the substratum.

Zygnema forms knob-like haptera (or rhizoidal out-growths) from the side of a single cell in the middle of the filament or sometimes from each of two adjacent cells of the filament. Rhizoid-like organs of attachment have not been noticed before in *Zygnema*.

Mougeotia is most interesting. The end of its filament coils itself spirally round a filament of *Spirogyra* or round another *Mougeotia* filament. This coiling is evidently a method by which it secures an attachment. Knob-like haptera are also formed from the sides of the cells sometimes.

In all these cases the formation of the rhizoidal attachments or the coiling of the filament appears to be the result of tactile stimulation.

A case of axial prolification of the flower of *Nymphaea rubra* Roxb.—*By* P. M. DEBBARMAN.

In the Calcutta Herbarium there is a curious-looking specimen of *Nymphaea rubra* Roxb. exhibiting axial floral prolification and phyllomorphy of the stamens. In this specimen a supernumerary flower has proceeded from the axil of a petal, the stamens have become transformed into leaf-like structures, and in place of the ovary and the disk there is a hard structure, filled with a brownish-yellow mass and covered with intricate woolly hairs. In the supernumerary flower no trace of ovary or any anther is visible. The leaves have become considerably altered in size and shape. It seems quite probable two kinds of factors, one "internal" and the other "external," may have been the cause of these structural deviations.

Two new Indian plants.—*By* P. M. Debbarman.

1. *Crotalaria topouensis*, sp. nov., Leguminosae-Genisteae-Eriocarpeae, from Topou, South India. Intermediate between *C. madurensis* Wight and *C. candicans* W. and A., in Flora of British India.

2. *Homalium ciliatum*, sp. nov., Samydaceae-Homalieae-Blackwellia, from Sikkim and the Garo Hills. Stands between *H. zeylanicum* Bth. and *H. bhamoense* Cub. and Sm., in Flora of British India.

Two new Assam plants.—*By* P. M. Debbarman.

1. *Eurya japonica* Thunb., var. *Kanjilali*, var. nov., Ternstroemiaceae-Ternstroemieae, from the Khasia, Jaintia and North Cachar Hills. This new variety is most closely allied to var. *nitida* Korths

2. *Sterculia attenuata*, sp. nov., Sterculiaceae-Sterculieae-Eusterculia, from Sylhet and Khasia. Closely allied to *S. Roxburghii* Wall.

The algal flora of Bombay Island and its immediate vicinity the Salsette.—*By* V. N. Hate.

The paper is a preliminary report on the algal flora, marine as well as fresh-water, in the vicinity of Bombay. The families and genera more commonly met with among the Myxophyceae, Chlorophyceae, and Characeae are recorded.

Geographical distribution of the Bengal species of Polyporaceae, along with a short history of them in Bengal. —*By* S. R. Bose.

So much of the world remains unexplored that a general view of the distribution of fungi is as yet impossible. Damp tropical forests yield the greatest numbers of polypori. The same species often occurs in widely distant parts of the world when climatic conditions are similar. Changes in physical conditions, due mainly to the activities of man, result in the gradual disappearance of many species.

Of the Polyporaceae now known from Bengal, some are practically cosmopolitan; some have an extraordinary discontinuous distribution, due perhaps partly to our imperfect knowledge of the fungus flora of different regions; some are restricted to British India, Ceylon, and the Eastern Tropics; while recent work of the author extends the range of a number of species to Bengal.

All the records of Bengal Polyporaceae are included in the papers of Berkeley (Jour. Bot. and Kew Garden Misc.) Curbey (Trans. Linn. Soc., 1874), Cooke (Grevillea, 1874–91), Massee (Kew Bull., 1898–1912), and in recent papers of Lloyd and the author.

A note on the vegetation of Khajiar, near Chamba in the N.-W. Himalayas.—*By* B Sahni.

Attention is drawn to a remarkably clear example of zonation in the vegetation, apparently determined solely by a single factor, namely, water. Khajiar is a roughly circular meadow with a gradual slope towards the centre, which is occupied by a tiny lake. Round the lake, which contains a familiar aquatic flora, there are several concentric zones, each one drier than the zone inside it, and characterised by a flora strikingly distinct in its general appearance and colouration.

The author exhibits some photographic views of the meadow, in which the concentric zones are clearly seen.

The ecology of the Nilgiri Hilltops plateau.—*By* P. F. Fyson.

The Nilgiri Hills form a plateau, isolated by steep sides and long stretches of plain from any other high lands. The plateau is divided botanically and climatically into two well defined halves. The western side has abundant rain during the summer months but is very dry during the remainder. The eastern side has lighter rain, more evenly distributed throughout the year. The vegetation however is more xerophytic on the latter half, and the reason lies in the thinner soil. The difference in soil is due to the cultivation of this tract by an agricultural people, attracted thereto by the suitable climatic conditions. On the western side however, the climate not being suitable for agriculture, a pastoral people has settled down and they have not destroyed the natural covering of the soil.

The western side is thus the natural climatic climax of the local conditions; the eastern vegetation is a degredation product.

The oecology of some plant communities in the Savannah formation.—*By* W. T. Saxton *and* R. H. Dastur.

The authors have studied the vegetation of an area near Ahmedabad with a view to elucidating the causes which lead to marked differences of vegetation in an area where the majority of the physical factors are practically uniform, and where the whole area belongs to the same formation although the communities are different.

This area has shown, during the last seven years, a fairly sharp distinction into four parts, and in some cases the dividing line between the communities is very abrupt.

In order to arrive at any definite conclusion five lines of research seemed to be desirable: (*a*) a detailed analysis of the vegetation of the four parts; (*b*) an analysis, chemical and physical, of the soils, including the water content; (*c*) an investigation of the root systems of some of the more dominant plants; (*d*) a study of the physiological anatomy of the plants concerned; and (*e*) experimental determination of the wilting point of the more important plants, and their rate of transpiration under controlled conditions.

The present account includes the first three only of these.

The authors show that the differentiation into plant communities depends upon edaphic factors and have studied the relationship between these factors and the communities investigated. They also find that in very many cases the possession of a very long straight, unbranched, tap-root is the only recognizable "adaptation" by which the plants of this formation are able to survive eight rainless months.

Notes on forest successions in the Gangetic Plain and the adjoining Vindhyas.—*By* L. A. Kenoyer.

With a view to the determination of the character of the forest vegetation of this portion of India and the order of its successions, notes have for several years been taken on the species distribution of trees and shrubs on the plains about Allahabad, at several points all along the edge of the Vindhiyan uplands which begin within ten miles of the Jumna and Ganges, at several points in the vicinity of Manikpur, some twenty miles within the edge of these uplands, and at several points about Jubbalpore, in the heart of the C.P. forests. The following generalizations can be drawn:—

1. The forests of this entire region are of the monsoon deciduous type of Schimper. The thorn forest, which has been ascribed to part of this region, is apparently but a pioneer stage in the progression toward the monsoon type.

2. Because of the heavy population of the plains there is here no forest in the climax stage. As one proceeds southward the population gradually decreases and the amount of forest which has reached or is approaching a climax correspondingly increases. Since there is no great difference in the rainfall, it is believed that man and his grazing animals are responsible for the lack of the later stages in the more populous country.

3. The trees of the later stages lose their leaves at times varying with the species from October to April, but are practically all leafless by the end of April. Leafing out occurs rather before the commencement of the monsoon rains.

4. The few evergreens, such as *Eugenia Heyneana*, *Ixora parviflora* and *Buchanania latifolia* are for the most part hydrarch pioneers in stream valleys and in seepage seams on the rocks.

5. Flowering is distributed through practically the entire year but is most abundant in the spring season, about February and March, and during the monsoon, about August and September.

6. The climax forest of the Jubbulpore region is one with *Tectona grandis* and species of *Terminalia* prominent These species do not occur in the other regions investigated, but as they grow readily when planted it is possible that the stress of human occupation has eliminated them.

7. In regions where the stress is greatest, as the Gangetic plain scarcely any timber is found beyond the pioneer stages. The trees and shrubs found in these coppice well, as a rule, and are protected from the attacks of animals by thorns, by tough harsh leaves, or by a bitter cell sap. *Acacia arabica*, *Dalbergia Sissoo* and *Butea frondosa* are found in almost pure groups. The first of these is common on low-lying, the last on higher areas. Along the edge of the hills an intermediate stage is reached consisting largely of *Diospyros tomentosa*, *Lagerstroemia parviflora*, species of *Anogeissus*, and *Bassia latifolia*. In many places the last, because of the great value of its flowers and fruits, is practically the only tree which escapes periodic cutting, hence becomes the largest tree of the forest.

8. There is a general difference in the composition of the forests of the plains and of the hills because of differences in the soil. Some trees undoubtedly have difficulty in getting their roots to sufficient depth in the rocky soil of the hills, while others thrive better here than on the plains. For example, *Lagerstroemia parviflora* and *Diospyros tomentosa* are rare on the plains. *Acacia arabica* is a pioneer on low flat plains, while *Acacia leucophloea* occurs generally at the lower and *Acacia catechu* at the higher elevations in the Vindhiyas.

An oecological study of Deccan grass land, II.—*By* G. M. Chakradeo.

1 This paper is in continuation of one read at the last Science Congress which contained results of 1920. This paper deals with the results of 1921.

2. This year's study shows marked variation from last year in the time of flowering of several species. Many additional species have come under observation. Some of last year's species are reduced in number, and others are extending their distribution.

3. The permanent quadrats are much changed from last year. Some have increased their population of various species, others are reduced in them. The dominants in each have remained constant except in quadrat I, in which an additional dominant has appeared.

4. Plant societies have become much more prominent. In addition, there have been discovered a few colonies of pure species.

5. Variety in the flora, and its changing nature from year to year have become very prominent.

6. The cultivated and reseeded middle strip has not stood to advan-

7. Firmer establishment of good fodder grasses on poorer spots, the gradually increasing area of marvel, and the extension of *Ischaemum laxum* on the land are hopeful features.

8. The different tests of land improvement applied show favourable results, and the experience so far gained gives good hope of success.

Field notes on the Loranthaceae of Southern India.—*By* C. E. C. Fischer.

1. Comparatively little has been published on the subject.

2. The order is of some economic importance as some of its species injure economic plants

3 Theories as to susceptibility or immunity from attack are reviewed and criticised.

4. The notes refer to 23 specific parasites and 6 varieties and 218 host plants.

5. No new theory has been suggested but the observations refute all the existing theories as far as known except that of races within the species.

Some foreign weeds recently introduced in the neighbourhood of Lahore.—*By* S. R. Kashyap.

Several foreign plants have established themselves in the Panjab plains and are well known. *Argemone mexicana, Erigeron linifolium, Malvastrum tricuspidatum, Opuntia* sp., etc., are examples.

Some others have been noticed during recent years and are described in the paper. These are either (1) brought from the Himalayas by the rivers and then find their way into the fields through the canals, or (2) they have come from foreign countries. Among the Himalayan plants are *Hydrocotyle rotundifolia* and perhaps *Sagina apetala*, and *Lactuca scariola*. Among the foreign plants the following are noteworthy: *Senebiera didyma, Oxalis pescaprae, O. corymbosa, Ammi majus, Tridax procumbens, Nicotiana plumbaginifolia, Ruellia tuberosa, Verbena bonariensis. Euphorbia geniculata, Eichornia crasspies*, and *Nothoscardum fragrans*.

A note on pollination and its economic importance in some of the chief crops of the Central Provinces and Berar.—*By* K. P. Shrivastava.

1. Cotton.—Observations were made on *Gossypium neglectum* subvars. *malvensis, vera*, and *rosea* ; *G. indicum* var. *bani* ; *G. hirsutum* vars. *rufa* and *buri*. The flowers open between 7 and 10 A.M. Ordinarily self-pollination takes place, but insects, chiefly bees and butterflies, effect some cross pollination. The percentage of crossing varies with different varieties, and is described.

2. Bajra (*Pennisetum typhoideum*) is cross pollinated through the agency of wind and insects. Protandry prevents self pollination. Bees, especially *Aphis dorsata*, visit the flowers in great numbers.

3. Tur (*Cajanus indicus*).—In this typically papilionaceous flower, the anthers dehisce before the bud opens, and normally self-pollination results. But there is evidence that cross pollination also occurs. On clear days the flowers open at about 10 A.M. and begin to fade away the next day. Bees, especially *Xylocopa dissimilis* and *Aphis dorsata*,

visit the flowers in great numbers. The former visits about 20 flowers per minute.

Conclusion.—In order to introduce any improved strain of any of the above crops in a particular locality, it is necessary to grow that strain completely isolated from other varieties of the same.

A short note on the short-cut to the nectar in the flowers of *Castanospermum australe* C. and F.—*By* P. M. DEBBARMAN.

During the flowering season, March and April, the flowers of *Castanospermum australe* in the Royal Botanic Garden at Sibpur are visited by sun-birds (*Mirafra assamiça*). They clip off with their beaks the basal portion of the vexillums, less frequently the alae, or rarely the carinas, just above the calyx cups, and suck out the nectar. During the process the birds probably become dusted with pollen, and thus become pollinators. There is no convincing evidence that they eat any of the fleshy petals they clip off.

Some observations on the anchoring pads of *Gymnopetalum cochinchinense* Kurz. and some other cucurbitaceous plants —*By* P. M DEBBARMAN.

Ampelopsis quinquefolia Michx. and *A. Veitchii* Hort. are frequently used as examples of plants with "anchoring pads" on the tendrils. Such pads are also found among the Bignoniaceae and Cucurbitaceae. The plants mentioned in this paper, being chiefly tropical, seem not to have been studied previously.

Under normal conditions a tendril of *Gymnopetalum cochinchinense* Kurz. coils about a support in the usual way. But if the tendril comes into contact with a rough flat surface, the epidermal cells in the region of contact give rise to papillae, which develop into multicellular linear-oblong or clavate trichomes that fit themselves so closely to the rough surface as to effect a firm attachment. The contact usually is strengthened by branching of some of the trichome cells. Such a pad will support a weight of nearly 150 grains (Apoth.). It seems that shade and moisture favour, while strong light and drought retard the development of these organs. There is no evidence of any mucilaginous or resinous secretion ; attachment appears to be mechanical. These pads provide an alternative means of scrambling, appearing when ordinary coiling-tendrils are of no use. After attachment, the free portion of the tendril coils, an illustration of "co-adaptation."

Such anchoring pads are found in *Trichosanthes palmata* Roxb., and are suspected to occur in a few other Cucurbitaceae.

The photosynthetic system of Cyperaceae.—*By* M. S. SABHESAN.

Haberlandt has made a passing reference in his book on the "Physiological Plant Anatomy," to the occurrence of a peculiar arrangement of the photosynthetic system in certain species of Cyperus. An attempt is made to examine the members of Cyperaceae with special attention to the photosynthetic system. It is seen that two types of arrangement prevail in Cyperaceae, (1) *Circum-vascular* or *girdle type* and (2) *Intervascular type* or *non-girdle type*. The girdle type is more common and I have noticed its occurrences in 24 out of 29 species belonging to 7 genera. The girdle is highly specialised and it consists of a number of sheaths arranged one inside the other around the vascular bundle. The outermost sheath consists of a close ring of palisade cells. The intervascular type is rare and this type goes hand in hand with a special feature of the vascular bundle which shows towards the outside a prominent sheath of colourless polygonal cells. The photosynthetic system of the Gramineae is also of two kinds as in Cyperaceae, and the girdle type shows varying degrees of specialisation in grasses. The girdle type is characteristic of Glumiflorae, and the non-girdle type has arisen at a later stage.

A case of plant surgery.—*By* L. B KULKARNI.

A baobab tree (*Adansonia digitata*) more than 300 years old and 70 feet in girth was so badly attacked by rot that the whole heart of the main trunk had disappeared. In 1920 the affected parts were carefully cut away and the raw wood tarred, then the cavity was filled with rubble and thoroughly concreted over. The tree responded by unusually fine foliage in 1921.

In the Deccan, *Garuga pinnata* and *Casuarina equisetifolia* trees also have been successfully treated.

Some abnormal phylloclades of *Opuntia elatior*, Mill.—*By* G. B PATWARDHAN.

The writer has described and photographed several malformations of joints of *Opuntia elatior*, Mill, observed in various tracts of the Bombay Presidency. The forms vary in their outline, spininess, form and the position of their origin parent. He has found the peculiar forms appearing more often in special situations in dry tracts The shapes include elongated, triangular, sickle-shaped, cylindrical, horn-like, etc., forms, all appearing from the normal phylloclade. The same phylloclade has shown a whole half or more of it a complete absence of thorns. Besides crowding of branches, interchangeability of vegetative and reproductive structures is also described. The writer is attempting to propagate the types and is succeeding to a certain extent. Some of the forms are showing signs of reproducing their variant characters. Still it is too early to give an authoritative statement. The ultimate search is for a spineless fruit growing from a normal phylloclade or a spineless one

A study of the genus Triticum in Central India—*By* G. K. LELE.

1. A botanical and agricultural survey of a crop is essential prior to the commencement of any experimental work devised for improving that particular crop, in the present instance, wheat of the Gwalior State.

2. The results of wheat investigation done within the Gwalior State are equally applicable to the rest of Central India.

3. The botanical survey of the wheat crop of the Gwalior State shows that the subspecies, Durum, is naturally suited for dry farming on the heavy black soils, and the subspecies, Vulgare, for the irrigable loamy alluvial soils of Central India.

4. The importance of local variety trials is sufficiently realised, but for the purpose of a critical selection of the most suitable sorts, a collection of cultivated varieties from foreign countries is desirable, if possible at the beginning of such a project. The response of Federation, Early Barrt, Columbia and some durum wheats recently introduced from the U.S. of America, has been satisfactory at Gwalior.

5. It would be more advisable to carry on experimental work with pure lines of wheat in every locality as it would show the effect of the sum total of soil, climatic and cultural variables. Such a system would give more valuable results than the one in vogue in India, of issuing certain wheats from a research station. Productivity plus quality should

be the first consideration; in case the combination of the two objectives is impossible, productivity should be given preference to quality.

6. In connection with item "5" it may be mentioned that an area of 5 to 8 acres, would be sufficient for variety and strain tests. If economy of time, labour and space is sought, two-row tests with replicates should be followed. This system has proved useful and satisfactory at the Gwalior Experimental Farms and is already in practice in many experimental stations of the U.S. of America.

Variations in the *Gossypium neglectum* types of cotton.—*By* S. H. Prayag.

In the course of the writer's detailed study on the principal five types of *G. neglectum* cottons grown in Khandesh, a good deal of variation in the characters of leaves fruiting branches, bolls, etc , was noticed in each of the types and the following are a few of the salient facts observed:—

(1) *Neglectum roseum* (N.R.).

A distinct type of plant noticed had the following characters:—

Leaves and stems hairy; height varying from 1½ to 3 feet; small leafy growths at the axils of the leaves; accessory lobes absent; staple fine and distinctly longer than the ordinary N.R.

Another type of plant having more deeply lobed leaves and with the accessory lobes absent, was noticed.

(2) *Neglectum roseum, cutchica* (N.R.C.).

In this, four types of plants having different-shapes of bolls were observed. Plants having globose bolls could easily be distinguished in the very early stage by the stem being hairy and more by the leaves being more broad than the ordinary type of N.R.C

(3) *Neglectum vera* (N.V.).

Four distinct types of plants having different shapes of bolls were noticed. Plants having oval bolls had smaller bracteoles than the others and possessed fruiting nodes at shorter lengths.

(4) *Neglectum vera, malvensis* (N.V.M.).

As in N.V., four types of plants having different shapes of bolls were found.

(5) *Neglectum vera, Kathiavarensis* (N.V.K).

In this, two distinct types with variations in the shape of bolls were noticed.

The determination of seed weight and weight or lint per seed in *Gossypium hirsutum*.—*By* G. R. Hilson.

Introduction.—Material used. Points to be considered in devising a method: (1) size of sample; (2) effect of changes in humidity.

Sampling.—Probable error of estimating average weight on 10 seeds determined from produce of one plant, humidity effect eliminated. Reduction in error by increasing size of sample to 100 seeds.

Humidity.—Method of determining fluctuation in weight due to fluctuation in humidity. Similarity of graphs of average weight of seed, average weight of lint per seed and of humidity. Humidity effect not sufficiently great to warrant elaborate precautions being taken, may be ignored or rendered negligible by arranging weighments.

Conclusion.—Results of examination of a large number of single plants, for these two characters.

On some petrified plants from the Mesozoic and Tertiary rocks of India and Burma.—*By* B. Sahni.

The author describes five specimens of silicified woods, three of them belonging to Conifers and two to Angiosperms.

1. Coniferous Wood. *Age:* Upper Gondwana (Rajmahal Group) of South India.
2. Coniferous Wood. *Age:* Sripermatur Group, Madras Presidency.
3. Coniferous Wood. *Age:* Cuddalore Sandstone Series, South India.
4. Dicotyledonous Wood. *Age:* Tertiary of Burma. The specimen is probably specifically identical with *Dipterocarpoxylon burmense*, Holden, but it shows a number of structural features hitherto undescribed.
5. *Palmoxylon Wadiai*, sp. nov., a silicified palm stem from Jammu. *Age:* Probably Siwalik (the specimen was not found *in situ*).

Section of Geology.

President:—G H. TIPPER, ESQ., M.A , F.A.S B.

Bearing of geology on some engineering problems in the Bombay Presidency.—*By* N. N. AYYANGAR *and* G. G. NARKE.

The engineer is essentially a geologist as he has often to solve problems which involve geological principles, but as things are at present in India they do not get the full benefit, in their training, that a study of geology in its different branches contributes to the problems they are called upon continuously to solve. The authors in their paper refer to the following interesting engineering problems in the Bombay Presidency which resolve themselves to be geological questions with a view to exemplify the importance of geology to engineering.

The bearing of geology on irrigation, particularly in the Deccan area, is fully discussed, with illustrations of the water-logging and salt efflorescence from Baramati and Malad areas near Poona and remedies to avoid the mischief on future schemes and to restore the spoiled areas to almost the normal conditions, are suggested. Similarly the question of the extensive cracking of the foundations and buildings on black cotton soil is taken up, in detail, and it is suggested that as the cracks are found to develop most, in the dry weather, they are produced by the tensile stresses, brought about in the concrete and masonry due to shrinking and splitting of the soil and not to sinking of the foundations in the soft ground. To prevent damage, therefore, it is explained that the foundations should be taken to such depths whereto the cracks do not extend on open sections, and that the intimate contact of the black cotton soil with the masonry should be prevented by about 6″ filling of loose stuff on the sides. Some river training problems are dealt with in conclusion with a study of the rivers of Gujarath and the Kanara Districts and Mr. Ayyangar's Law of the "Diversion of the Axes of currents in rivers" is explained, showing how to find out the effect of river training—works such as dams, bridges, etc., at one place, on towns, wharfs, etc., situated down the river. A new explanation is offered of the formation of bars at the river mouths and an instructive instance of a cause-way on the Bheema River is given to show that while the shape of the sand banks on the convex beds is permanent, the actual material is a continuously shifting one. The bar at the mouth is considered to be the last of the series of sand spits formed on the bends of rivers where the current takes a very sharp turn due to the obstruction caused by the sea.

Other interesting problems such as boring for sub-soil water supply, etc., are left over for future occasions.

Geological results of the Mount Everest Expedition —*By* A. M. HERON

Iron ores of Bihar and Orissa.—*By* H. G. JONES.

Note on the occurrence of bitumen in the Deccan Trap of Bombay.—*By* W. A. K. CHRISTIE.

On a bitumenous limestone outcrop, associated with marine fossiliferous strata in the Murree series at Jokau, Haveli Tehsil, Poonch, Kashmir.—*By* D. N. WADIA.

On the discovery at Kanneri near Bombay of one of the foci which contributed to the formation of the Deccan Trap of Western India.—*By* K. A. K. HALLOWES.

On the fossil Pectinidae from Hathab, Bhavanagar State, Kathiawar.—*By* H. C. DAS-GUPTA.

Palaeontological notes on the Nummulitic rocks of Cherra Punji, Khasi Hills, Assam.—*By* H. C. DAS-GUPTA.

On the Cancrinite from Kishengarh, Rajputana.—*By* S. L. BISWAS.

On the occurrence of Siphoneous Algae in the Tertiary of Sind.—*By* B. B. GUPTA.

Ostrea praelonga from the Bagh Beds.—*By* E. VREDENBURG.

Section of Medical Research.

President:—MAJOR J. CUNNINGHAM, B.A., M.D., I.M.S.

Presidential Address.

INDIA'S DEBT TO MEDICAL RESEARCH.

It is my pleasing duty as President to welcome you to this, the 4th meeting of the Medical Research section of the Indian Science Congress. To our guest, Dr. Kendrick, I would like to extend a special welcome in your name. The presence in our midst of a representative of the Rockefeller Institute, that great institution which has done so much for medical research, is an honour which we all of us appreciate.

The subject of my discourse has almost, one might say, been chosen for me. My distinguished predecessors in office have already dealt so fully with the present and future problems connected with medical research in this country, that they have left little or nothing on this subject to which I can profitably add. It is natural therefore that I should turn to the past for inspiration. It so happens, however, that the present time is particularly suitable for a careful consideration of our obligations to the past. Great changes are taking place around us. India is passing through a very definite and important metamorphosis, the results of which are bound to have far reaching effects on every branch of thought in the country. The responsibility for her progress in medical science has now devolved upon her people and her future progress will greatly depend upon the attitude adopted by her political leaders.

Science should have no politics, but the scientific communities cannot fail to be influenced by the great changes which are going on around them It is fitting, therefore, that we should review our progress up to the present before we set out on the new road which stretches away before us into the future.

In considering the remarkable progress made by the world during the past century, one is forcibly struck by the comparatively unimportant position assigned to medical science in the popular mind Ask the average man what he knows about the development of any outstanding mechanical invention and he will almost certainly give a fairly accurate account of the steps which have led to its actual discovery. When asked a similar question dealing with medical science he will in most cases plead ignorance and frequently show a complete lack of interest in the subject. It is not too much to say that the ordinary individual knows little or nothing of the development of modern medicine, nor does he realise his indebtedness to the research worker for the comparative freedom from disease which he now enjoys. India is no exception to the rule. The majority of her people are not yet in a position to appreciate the most elementary principles upon which modern medicine has been built, while her educated classes, in common with the rest of the world are more concerned with a host of other interests. Yet, as Osler says, "in little more than a century a united profession, working in many lands, has done more for the race than has ever before been accomplished by any other body of men. So great have been these gifts that we have almost lost our appreciation of them." The cause for this apparent indifference is not difficult to find. In most cases the advances in medical science have been so gradually introduced that they have almost escaped the notice of the people who have chiefly benefited by them. We take the least heed of those things with which we are in constant contact. It is only by looking into the past and contrasting the medical conditions which prevailed at that time with those of the present day that we are able to measure the progress which has been made.

In the early days of the British connection with India western medicine was just beginning to shake itself free from the various theories which has dominated it since the dark ages. The desire for truth, founded upon observation, was beginning to make itself felt. The example of such men as John Hunter and his pupils had acted as leaven, and had stimulated in the younger generation a desire for personal investigation into the morbid processes of disease. The views of Bichat, which placed the seat of disease in the tissues themselves as opposed to the organs, had not yet gained universal credence, and the nervous system was still regarded as the controlling factor in the various manifestations of disease. The clinical medicine of the time was comparatively simple. The arts of auscultation and percussion, recently discovered, had not yet come into general use. The fevers, with the exception of malaria and those which showed the characteristic eruptions, were as yet undifferentiated and included many diseases not known to have an entirely different etiology. Thus cholera was considered primarily a disease of the nervous system. One early writer indeed refers to concussion of the brain as the " lethi fabricator" of the disease, the purging and vomiting being regarded merely as sanitary processes

From the point of view of treatment all diseases belonged to one of two types, the sthenic and asthenic. It was only necessary for the physician to make up his mind which of the two he had to deal with to apply the treatment considered appropriate to the occasion depletion for the one, stimulation for the other. When we read of the lengths to which this treatment was carried we can well understand the feelings which prompted Stokes to say, " Oh ! that men would stoop to learn or at least cease to destroy !"

The microscope as yet played no active part in medical investigation. Its existence was however well known and there was much speculation as to the true relationship of micro-organisms to disease. In fact Plenciz in Vienna had, as early as 1762, enunciated what in effect was "the germ theory of disease." The Hippocratic theory of the causation of epidemic diseases that "diseases seldom have any other cause besides the air" still held the field. The exact nature of the harmful element was undetermined and was vaguely referred to as a poison which apparently generated where disease was in evidence. Epidemics were spread either by means of the air or by contagion. The latter view, although universally accepted, was bitterly opposed by the famous Sir Charles McClean whose main object in writing his book on " Pestilential Diseases " was to refute the doctrine of contagion which he said was a " gross superstition " introduced by Pope Paul III for a political purpose

It can well be understood that the medical profession at this time was in no position to control the terrible ravages of the various epidemic diseases which continually spread over the whole surface of the globe. No country was spared, whether in the east or west, in the tropics or more temperate zones. A competent authority of the time computed the world mortality from epidemic diseases alone at 15 millions annually, or 50°/₀ of the total death rate. The records of individual epidemics illustrate even more vividly the consternation and terror caused by these visitations. Here is an account taken from Heine of the outbreak of cholera in Paris in 1832. "On the 29th of March, the night of mi careme, a masked ball was in progress, the chahut in full swing. Suddenly the gayest of the harlequins collapsed, cold in the limbs, and underneath his mask "violet blue" in the face. Laughter died out, dancing ceased and in a short while carriage loads of people were hurried from the redoute to the Hôtel Dieu to die, and, to prevent a panic amongst the patients, were thrust into their graves in their dominoes. The grim horror of the situation can well be imagined. The terrible results of the various visitations of the plague in Europe are historical. During the outbreak of 1800, 76,000 persons were attacked and 15,000 died in Seville, a Spanish town with a population of about 80,000. The old cemeteries just outside the walls of Gibraltar bear witness to the havoc wrought by the same epidemic amongst the inhabitants of the Rock. Nearly 6,000 out of a population of 10,000 perished in four months. In India conditions were, if anything, worse. The large masses of people living under the most primitive and insanitary surroundings afforded an almost unbounded field for the spread of every kind of epidemic disease. Fevers, small-pox, plague and cholera each took a terrible toll from the unfortunate inhabitants who frequently looked upon them as a sign of divine displeasure to be averted by prayers and sacrifices rather than by precautionary measures. The exact mortality caused by these diseases will never be estimated. Contemporary literature, however, leaves no doubt as to their severity. Of an epidemic of relapsing fever one reads that "of numerous native villages nearly the whole population was ill at one and the same moment" and "the banks of the rivers were covered with the dead and the dying." A similar fever in Coimbatore and the neighbouring districts was responsible for the deaths of over 100,000 people between the years of 1809 and 1811. I have in my possession a letter written by a relation who was a medical officer in the army of the Marquis of Hastings in 1818. He describes an epidemic, probably cholera, which attacked the force at that time and, lasting just 4 weeks, carried off no less than 14,000 persons.

Innumerable instances of this sort might be given but I have said enough to illustrate the appalling state of affairs at the beginning of the 19th century, a period when at one time or other" every country in the world had the affliction to behold some portion of its inhabitants miserably perishing in thousands," "not only without being able to afford them the smallest relief, but in some countries without even daring to approach them with assistance.

What a contrast is presented by the scientific medicine of to-day. An "art" which had remained almost stationary since the days of Hippocrates, and which was governed to a great extent by theory and dogma, has in little more than a century developed into a great science based upon the results of experimental investigation. To the general recognition of the value of this method, and to this alone, can be traced the marvellous evolution which has taken place. No department of medicine has remained unaffected. In none, however, has research been productive of greater results than in that which deals with the etiology of disease. Indeed, one might go further and say that the investigations which proved beyond dispute the microbic origin of disease laid the foundations upon which the whole edifice of modern medicine has been built. Antiseptic surgery with all its latter day improvements, bacteriology, and serum and vaccine therapy can all trace their origin and much of their success to the researches which will for ever be associated with the names of Pasteur, Koch and Cohn. Preventive medicine was but ' a blundering science," until the establishment of the germ theory altered its whole outlook and gave a new direction to its energies. From small beginnings it has rapidly grown as new facts have been established until at the present day it rivals in importance the curative sides, and is by many looked upon as the medicine of the future. The recognition of the all-important part played by micro-organisms in the causation of disease has perhaps had a greater influence upon the development of tropical medicine than any other branch of medical science. What at one time was the province of the doctor alone has now to a great extent become the province of the medical zoologist. In addition to bacteriology, protozoology helminthology and entomology, each a separate science in itself, are now considered indispensable for the student of tropical medicine. The part played by the insect world in the transmission of disease, first demonstrated in the tropics, forms the most important contribution of tropical medicine to medical science in general, and one which has had a profound influence upon our methods of disease control. Through the labours of a host of tropical workers we now know the causes of the majority of the common tropical diseases and the means by which they are transmitted. In intricacy of development and in the wonderful ingenuity displayed in their passage from host to host the life stories of certain of these parasites may well be compared with the romantic descriptions of insect life left us by the great naturalist, Henri Fabre. The geographical distribution of tropical disease is now known to be largely a question of the indigenous insect fauna, and its seasonal prevalence is probably governed by the necessity for certain meteorological conditions which must be present before the life cycle in the insect host can be completed. Thus the old Hippocratic theory of the causation of disease has received indirect support from the results of modern research.

The deficiency diseases which came into such prominence in Europe during the war have long been recognized in the tropics. Workers in the East have frequently referred to the shortcomings of the eastern dietary and its probable connection with liability to disease. A correct appreciation of these facts is most important in countries where the majority of the population live in the ' twilight zone. '

Modern treatment is also the outcome of experimental investigation. Polypharmacy has fallen into disrepute and has been replaced by the belief in a few well tried drugs, the efficacy of which has been proved by experiment The search for specific parasiticides has been a prominent feature of pharmacological research ; the older specifics of the vegetable world have been subjected to chemical analysis and have in many cases yielded their active principles. Medicine has not hesitated to apply to her own use the advances in other sciences. Electricity, X-rays and radium are now recognized methods of treatment. No better illustration of the complete subversion of the older methods can be given than the modern hypertonic saline treatment of cholera, which has replaced the recognized method of a century ago, " exemplified by the following old prescription. " Mitter. Sangui e brachio magno orificio, add. oz. XXX. aut usque ad syncopen."

The prominent part which has been played by workers in India in this marvellous development has been the subject of a graceful tribute by Sir William Osler : Speaking of medicine in Greater Britain, he says, " Quickly there arises the memory of the men who have done so much for British medicine in that great Empire. Far from their homes, far from congenial surroundings and far from the stimulus of scientific influences, Annesley, Ballingall, Twining, Morehead, Waring, Parkes, Cunningham, Lewis, Vandyke, Carter and many others have upheld the traditions of Harvey and of Sydenham. On the great epidemic diseases how impoverished would our literature be in the absence of their contributions !"

What India owes to the medical research can be inferred to a great extent from the contrast which I have just drawn. Many of the gifts she has received in common with the rest of the world. They are none the less valuable for this, nor are they less freely offered, for science made no distinction between race, creed or class. Applied to the relief of the multitudes stricken by disease or accident, modern medicine has brought about a reduction in suffering and misery undreamed of by a people which for ages has sat in darkness and in the shadow of death.

In the realms of disease prevention, if the results are less tangible, they have infinitely greater possibilities. We can point to the tremendous decrease in mortality which has followed the introduction of measures based upon the results of investigation. Especially is this the case in the controlled population, such as are found in the army and the jails. We can point to the close relationship which exists between disease prevention and the economic factor, a subject which up to the present has received but little attention in this country.

The greatest triumph of medical science, however, is the complete change in our attitude towards disease. The feeling of despair has changed to one of confidence and hope. The medical profession can now claim to control many of the devastating epidemics which previously held the world in fear. Science now teaches that disease is preventable and that all may be healthy and happy if they will but obey the laws of health. It is in the observance of these laws that India lags so far behind. The mass of her people are even yet hardly aware of their existence and passively oppose the most elementary measures designed for their own safety. Sanitary reform is the most urgent Indian problem of the day, for without material progress in this direction India cannot hope to take her place amongst the great nations of the world. Medical research has pointed the way. It is now within the power of the people themselves to decide what use they will make of the gifts science has placed within their grasp. It is the sincere hope of all of us that the era which has now come will be as productive of good as the one which has just passed.

The ultimate aim of Medical Research.—*By* LT.-COL. J. W. CORNWALL I.M S.

All diseases can be classified thus :—

1. Due to accidents.
2. Due to physical agencies.
3. Due to chemical agencies.
4. Due to specific parasitic agents
5. Due to disturbed function.
   (*a*) metabolic.
   (*b*) mechanistic.

They are all preventable, some by State agency, the rest by the individual himself.

We are now spending far too much time, money and energy in investigating the pathological processes of declared disease and in trying to elaborate cures, and far too little in trying to learn the causes for original deviations from a state of health.

The main efforts of medical research workers should be directed towards the discovery of conditions which permit a disturbance of the functions of the organs of the body to occur.

Pathological and therapeutical studies which have not this end in view are of secondary importance.

Note on the Weight Curve of the Normal Indian Infant during the first year.—*By* Miss D. F. Curjel.

This paper was the result of 842 observations made at the "Baby welcome" centre at Delhi. A previous series of weights at birth gave an average weight of 6½ lb. While it is obvious that many more observations are required before an average weight curve of real value can be obtained at Delhi, the author thinks that the observations recorded are sufficient to indicate that there is a slight loss of weight in the second week, and that this is rapidly made up and followed by a steady rise during the first three months of life which is the period of most rapid increase. At the end of the twelfth week the average weight is over 10¼ lb. From the 3rd month onwards the rise is more gradual, at the end of the 24th week the average weight being 12½ lb. The average weekly gain during the first six months is about four ounces. From the sixth to the twelfth month the curve as indicated on the chart was more theoretical as fewer observations were recorded at these ages. During this time the rise was seen to be more gradual and at the end of the first year the child weighed about two and a half times as much as at birth. The object of the note is to bring before those concerned with infant welfare in India the desirability of recording weights of the infants under their observation in such a way that accurate records from different parts of the country may be collected.

Bovine Tuberculosis in India. An outbreak of tuberculosis among animals in the Bombay Zoological Gardens. *By* Lt.-Col. W. Glen Liston *and* Dr. M. B. Soparkar.

Tuberculosis among cattle is rare in India at least in the western Presidency. In view of this fact it was of interest and importance to investigate the nature and origin of an outbreak of tuberculosis that occurred among animals in the Bombay Zoological Gardens about the end of 1915. The investigation showed that the disease which had spread to some thirty animals consisting of deer, llams, antelopes, etc , was bovine in nature and that it originated in all probability from the llamas which were imported from Germany and from one which died of tuberculosis in the gardens. The fact emphasizes the danger of importing into India animals from foreign countries where bovine tuberculosis is common without proper safe guards to endure their freedom from the disease.

On some observations on Tubercle Bacilli in culture with special reference to the properties of an Endolipase.—*By* Lt.-Col. R. Row, I.M.S.

The known biological fact that animal or vegetable cells yield enzymes has been extended to bacterial cells also. These bodies being specific according to the richness of particular proximate principle it may be assumed that tubercle bacilli rich in fats and would be rich in lipase much in the same way as castor seed, or as bacillus diphtheriae or bacillus pestis is known to yield proteases under certain conditions The object of the present paper is to ascertain what enzymes if any, can be demonstrated in a mass of T. B. grown on solid media and their action on the same during autolysis. Two kinds of enzymes are demonstrable, one a proteolytic and the other lipolytic. Both produce changes in the tuberculous mass physical, chemical and microscopic. The result is the liberation of a mixture of fatty acids demonstrable by acid reaction and formation of complex soaps. The microscopic changes result in the alteration in the staining characters of the bacilli, in their thining and erosion obviously resulting from the solvent action on the waxy material. The T.B. when the action is complete become non-acid-fast. The protease produces a gummy material partially soluble in the fluid of a saline emulsion. The liberated fatty acid can be extracted with petrol-ether filtered through pasteur chamberland bougis and freed from solid particles of T.B. and when evaporated gives an orange coloured waxy-mass soluble in chloroform and from this soaps are available with proper neutralisation with akkali.

These soaps, from preliminary observations, produce in minute doses definite local and general reaction in tuberculous patients. Observations on the influence of these salts in the lipase stimulation in man infected or otherwise and also experiments *re* immunity production with this product and the observations of the action of the de-fatted T.B. in the same direction are in progress.

Note on the Ratios of the Numerical Content of certain Bacterial Suspensions obtained by the Haemocytometer method to those obtained with Brown's opacity tubes.—*By* MAJOR J. CUNNINGHAM., I.M.S., *and* B. TIMOTHY.

The opacity method of enumerating bacteria introduced by Brown was originally based on numerical equivalents estimated by a combination of Wright's and Braxton Hick's methods. In a later communication the rates of the numerical content of bacterial suspensions obtained by the haemocytometer method to his original table (taken as unity) was only given for B. typhosus, B. paratyphosus A and B, paratyphosus B.

A further series of other common organisms have been submitted to a similar procedure and their ratios to Brown's original table have been estimated. The results which have been obtained so far correspond closely with those given by Brown. The numerical value of the opacity tubes as estimated by the Haemocytometer method is somewhat higher than the values originally given by this author. The ratio between the old and new methods varying between 1 to 1·2 and 1 to 0·9 for different origanisms.

The value of formol-gel test for syphilis.—*By* S RAMAKRISHNAN.

The formol-gel test for syphilis, the Wasserman reaction and the clinical histories were compared in 120 cases. The Wasserman reaction agreed with the clinical histories in 93·33% of cases.

While in only 64·1% of the cases the formol-gel test agreed with the clinical histories.

Thus the formol-gel test stands condemned when compared with the history of the cases as well as with the results of the Wasserman reaction.

On reversion of the Flagellate form of Leishmania donovani and Leishmania tropica to the resistant non-flagellate, torpedo and O body in culture tubes and its bearing on the attempts at the search for the transmitter.—*By* LT.-COL. R. ROW, I.M.S.

In experimental infection with leishmania the resistant torpedo or O body phase of the parasite is a sine qua non. In the search of insect transmitters, it has been the fashion with some workers to attach too much importance to the presence of flagellate forms, which by themselves are (in the author's hands) valueless from an infection point of view as they are far too delicate to withstand the action of body fluids and phagocytes. Now there is no evidence of a single positive experimental infection with flagellates found in the so-called transmitters while there is evidence of old cultures containing resistant forms yielding a positive result; therefore a series of observations were undertaken to study the various phases of reversion from the flagellate to the resistant forms and the following points were recorded week after week from surface growths on N.N.N. medium which was found to be the most suitable for the purpose

1. Enormous division and sub-division of active flagellates of various sizes and shapes by simple fission. (First two weeks.)
2 Sluggishness and loss of mobility of the flagellates accompanied by a shortening of the flagellum and a simultaneous migration of the blepharoplast towards the nucleus and vacuolation of the cytoplasm. (Third week.)
3. Shortening and fattening phase of the parasite with the complete disappearance of the rudiments of the flagellum and closer apposition of the blepharoplast to the nucleus and increased vacuolation leading to the complete formation of a thin capsule which is cast off or absorbed. (Fourth week.)
4. Rounding off of the parasite before assuming the form found in the lesions. (After fourth week.)

From the above it is clear that in the search of a transmitter the endless variety of morphologically different flagellates, flagellates and 0 bodies, would lead to enormous difficulties in identifying the parasites even incultures and therefore all the more so in the intestinal contents of insects inflicted naturally with different kinds of herpatomonas; and in the absence of a single experiment proving the infectivity of these in susceptible animals it is premature to assert and condemn any particular insect be it a bug, a flea or a phlebotomus, simply on the evidence of finding flagellates in their intestines even several weeks after an infective feed.

Note on the Cultivation of Leishmania donovani from the peripheral blood of persons suffering from Kala-azar.—*By* LT.-COL J. W CORNWALL. I.M.S., *and* H. M. LAFRENAIS.

The authors related ten successive successful cultures of flagellates from the peripheral blood in kala-azar for purposes of diagnosis and gave the method employed. They described a much simpler and equally successful method of cultivating the flagellates. This consisted in using much larger quantities of blood suitably diluted and incubated in flasks. Suggested that it be definitely decided by those who have access to numerous patients with kala-azar whether the method is really of value in aiding early diagnosis in doubtful cases.

The diagnosis of Kala-azar by peripheral blood culture.—*By* BIRAJ MOHAN DAS GUPTA

Between March 3rd and August 1921 the peripheral blood of 35 cases of kala azar was submitted to culture to N.N.N. medium. Nineteen of these patients had had no antimony treatment whilst in the remaining sixteen varying amounts of antimony had been given.

All those cases except two were culturally positive. The average time when flagellates first appeared in the cultures was just under eight days (Shortest period 3 days longest 22 days.) The two negative cases had each undergone a complete course of antimony (200 c.c. of 1% sodium antimony tartrate) but had not shown much improvement in the clinical condition. Though the peripheral blood culture in these two cases was negative in both cases leishmania were found microscopically in spleen smears. Two cases which were positive both by peripheral and splenic blood culture were negative by microscopical examination of blood and spleen juice.

These shew that the diagnosis of kala-azar by culture of the peripheral blood is in skilled hands, little, if at all, less reliable than microscopical examination of spleen juice.

The value of culture of the peripheral blood in Kala-azar as a diagnostic procedure.—*By* T. SEETHAPATHY IYER *and* K. V. KRISHNAN.

The results appear to show that the culture method, used purely for purposes of diagnosis and not merely as a corroborative test, gives information of value in about 25% of cases.

The more advanced the case is at the time of culture the greater the chance of success.

Repeated culture, where possible, is of value.

The tubes should be inoculated for a long time extending to about 40 days before a negative result can be recorded.

The problem of Kala-azar.—*By* MAJOR F. P. MACKIE, I.M.S.

Major Mackie drew attention to the prominent part which had been played by workers in Madras in the investigation of kala azar. In dealing with the parasite he referred to the possibility of a stage in its life-history which was at present unrecognized Such a supposition would explain to some extent its presence in culture when it could not be demonstrated under microscope. In dealing with the clinical aspect of the disease he referred to the difficulties in diagnosis and the value of the different methods at present available for the purpose. He pointed out that Cornwall's method of cultivating the parasite promised to be one of the most valuable of these methods. He then proceeded to explain the possible means by which the leishman donovan body gained access to and escaped from the human being. He referred to the possibility of infection by means of the intestinal canal and also drew attention to an experiment which demonstrated the possibility of infection by means of the skin. He devoted more attention, however, to the controversy which at present rages round the transmission of the disease by means of an insect. Dealing first with the bed bug he discussed the work which had been done by Patton, Mrs. Adie, and Cornwall with this insect and pointed out that while the bodies observed by Mrs. Adie were most suspicious, further work had yet to be done before it could be finally accepted as a stage of leishman donovan body. He next discussed the position of the sand fly as possible carrier of the disease. He pointed out that it had already been proved that the sand fly carried a similar organism and recorded certain suggestive experiments which he had carried out in this direction. He finally dealt with the treatment of the disease by means of antimony tartarate. Some drawings illustrating leishmania like bodies found by Major Mackie in the bed bug were also demonstrated.

An investigation into Filariasis at Puri.—*By* P .N. DAS.

1. Certain aspects of the anatomy and physiology of Micro Filaria evidence in support of the probable physiological function, of the tongue like process.
2. Effects of the injections of solutions of different drugs upon the movements of M.F. under the cover glass in blood films Formalin, Tartar, Emetic, Novarsenobillon, Iodine etc.
3. Effects of the injections under cover glass upon sheathless Filaria and upon the developed stages of Filaria in preparations of mosquito body.
4. Mosquito dissection in Puri Jail and Sadar Hospital. One filari-

ated female prisoner infected 43% of the mosquitoes examined in jail and transmitted the infection to her fellow prisoners and when removed to hospital, infected 32% of the mosquitoes examined, 14 of which revealed the advanced stages of development of Filaria. The successive stages of Metamorphosis of filaria were observed in the mosquitoes fed upon the filariated female prisoner.

5 Metamorphosis of filaria is Culex Fatigans.

(1) Discussion of the phenomena observed in 55 positive specimens of mosquito stomach.
(2) Description of 13 different stages and discussion of the phenomena observed in the course of the developmental cycle in 92 positive specimens of mosquito thorax.

6. Question of the transmission of the infection from human being to mosquito and from mosquito to human being and of infection in groups of families.

7. Question of filarial endemicity in the Puri Municipality as determined by:—

(1) Mosquito dissection—44% infected.
(2) Examination of blood in a group of 118 men 31% positive.

8. Certain aspects of the pathology of the disease.

Findings from examination of a group of 153 cases in the different stages of filariasis.
Periodical filarial fever and the associated pathological conditions in a group of 52 cases.
Discussion of the prevailing ideas about the pathology of the disease and its bearing upon treatment.

9. Question of the incubation period and the seasonal variations in the appearance of M.F. in the peripheral blood.

10. Question of filarial periodicity. Diurnal and nocturnal variations. Presence of M.F. in blood during the day in Haemolysed and centrifugalised blood (diluted 15 minutes) peripheral blood being negative during the day.

11. Association of filariasis with ankylostomiasis. Mixed helminthic infection in a case. Micro Filaria in blood, Ascaris lumbricoides, Ankylostoma, Trichiuris Trichiuria ova and Strogyloides Larvae in faeces —(Haemoglobin 10%).

12. Treatment of Filariasis.

(i) Filariasis with M F. in blood, in cases followed up from 1919 and 1920. Counts in 1921 were 0 or varies from 0 to 5. Discussion of the mode of treatment.
(ii) 31 cases of elephantiasis treated in 1921 with marked results and in many cases restoration to normal condition. Discussion of treatment. Treatment must be intensive.
(iii) 11 cases of periodical filarial fever treated with marked results.

13. Discussion of reactionary phenomena and after Antimony injections in 110 cases.

14. Observations on the criticisms against the usefulness of Antimony injections in Filariasis.

Filariasis research (Darbhanga Research Memorial) Calcutta School of Tropical Medicine and Hygiene.—*By* S. Sundara Row.

The author gave an abstract of the work which had been carried out upon this subject at Cuttack during the latter part of the past year. He showed that the disease varied in intensity in different places and gave some interesting facts dealing with the relative frequency of various types of the disease. He also gave the results of investigation into the types of mosquito present and pointed out that nearly 10 per cent of the mosquitoes caught were infected with filaria.

On the occurrence of fugitive swellings on the extremities and trunks of persons suffering from Filariasis in India. —*By* LT.-COL. J. W. CORNWALL, I.M.S.

Fugitive swellings due to the temporary or permanent arrest of adult filariae in the superficial lymphatics of the trunk and extremities do occur in India, though apparently uncommon. If pyogenic organisms are present in the circulation an abscess may be formed. External pressure may be the cause of the arrest or death of the wandering filaria.

A filarial survey with a statistical enquiry into the Relationship of Filariasis and Elephantiasis.—*By* MAJOR J. A. CRUICKSHANK, I.M.S., MAJOR J. CUNNINGHAM, I.M.S. *and* T. SEETHAPATHY IYER.

This paper presented the results of a statistical survey of the disease in Saidapet a heavily infected area near Madras. Attention was specially diverted to the differences presented by the disease in South India and in other parts of the tropics especially Fiji.

These differences are especially in the microfilaria rate in cases of filarial disease particularly in elephantiasis. In India microfilaria are less frequent in cases of filarial disease that in those without filarial disease while in Fiji the reverse apparently holds good. The paper records the important observation that the proportion of persons affected with elephantiasis regularly increases with age.

Technique of staining and mounting Helminths in bulk. —*By* CAPTAIN VISHNU T. KORKE.

The technique described in this paper, is the outcome of personal trial.

Although the technique is similar for all different orders such as Trematodes, Cestodes and Nematodes, still it differs slightly in certain details for each order.

The type species from each order has been selected for staining and mounting purposes and it is probable that the method will apply equally well to other species. More than one method of fixation and staining has been described. A particular fixative or a stain need not claim superiority over other, fixative or stains and yet the picture effect is different in each combination.

A general routine method is described in the body of this paper while deviations from the method have been described in the footnotes.

Mass treatment of Hookworm infection.—*By* K. S. MHASKAR.

(Ankylostomiasis inquiry Trichinopoly).

At the time of the commencement of Ankylostomiasis inquiry in Madras in 1916, the treatment of hookworm infection was a drastic one as it required a careful preparation of the patient, rigid dieting, heavy dosage of the anthelmintic, and the use of strong purgatives. As hookworm infection was found to be universal in the Madras Presidency, this treatment was unsuited for the masses, and a simple and effective treatment which would be simple safe and efficient was to be desired.

Chemical, physiological, and therapeutic tests were carried out on

54 anthelmintics, the Trichinopoly central jail prisoners being treated for the purpose. The results showed that, with the exception of chloroform which may prove useful in *Ankylostomum* infection, only three drugs-oil of chenopodium thymol, and betanaphthol are more or less efficient.

Oil of chenopodium was found to be a mixture of several useful and useless constituents; the treatment with it is efficient, but toilsome, costly, and uncertain as to its safety. Thymol and betanaphthol treatments in single does of 5 grains without purgatives are simple, safe, and efficient, thymol being somewhat costlier than betanaphthol.

The above conclusions were based on the hook-worm removal with one test treatment; when based on the percentage of cures, 67 and 72% of cases were cured with thymol and betanaphthol respectively.

Addition of light magnesium carbonate increases the anthelmintic action of drugs.

The drugs were found to have a remote action which brings about 'delayed' cures, showing that except in proved cases of reinfection a treatment which is known to be efficient need not be followed by any other.

The two drugs thymol and betanaphthol gave equally good results in field work. The one dose treatment without purgatives is simple, safe and efficient. As no previous microscopical examination of faeces is required and as the drug need not be administered more than once, the treatment is likely to find favour with the masses.

The diagnosis of hookworm infection.—*By* K. S. MHASKAR.

The methods of diagnosis of hookworm infection are based on some features in the life-history of the parasite. The hookworm larva on entering the skin of the host, may cause the inflammatory phenomena of ground itch, and while present in the lung may cause bronchitis. On reaching the intestine the presence of the adult parasite may be detected directly by a large number of ova present in the faeces, or by the haemorrhage consequent upon the biting of the intestine, and, indirectly, by the changes brought about in the blood of the host. After the death of the worm, either natural or induced, the infection may be detected by the finding of adult hookworms in the faeces.

Hookworm infection, as distinguished from hookworm disease, cannot be diagnosed clinically, as, ground itch, its only clinical manifestation is absent in Southern India and in many other parts of India where the infection is equally highly prevalent. On the other hand the clinical diagnosis of hookworm disease is possible as it is based on the presence of anaemia and its effects; but the process requires careful elimination of all other causes of anaemia.

The diagnosis of hookworm infection has therefore to be based on laboratory methods. The object of this paper is to discuss the relative value of the several methods which have been proposed. These methods are based on the examination of (A) the faeces and (B) the blood of the host.

A. The examination of the faeces includes:—

1. testing chemically for the presence of occult blood;
2. a microscope examination for the finding of ova;
3. a culture method for the finding of the larvae;
4. the finding of adult hookworms removed by an efficient anthelmintic treatment.

B. The examination of blood includes:—

1. variation in the haemoglobin content;
2. the determination of the relative proportion of eosinophiles to other leucocytes;
3. a serological study with reference to complement deviation.

A simplified method for the cultivation of plasmodium in vitro.—*By* MAJOR J. A. SINTON, I.M.S

Cultural methods seem to have been neglected in the diagnosis of latent malaria chiefly because the methods hitherto described were not suitable for routine clinical use.

The following method was devised with the idea of getting a more practical method for testing the value of cultures in diagnosis.

The chief point in the method is the use of a special tube which can be used both for the defibrination of the blood and for growing the cultures. This tube is made from ordinary glass tubing with a spirit Bunsen burner. The blood needed is a few drops from the finger of a malarial patient with parasites in his blood.

The special tube consists of two chambers connected by a narrow stem about 2·5 mm wide. The upper chamber is shaped like a Wright's capsule and contains a few glass beads to defibrinate the blood. The lower chamber is conical with a capillary tube projecting from the base. This chamber and the stem act as the culture tubes.

In using the tube the upper chamber is filled half full of dextrose ascitic or hydrocele fluid. (1·5–2·0 cc. of 50% dextrose to 100 cc of fluid) and 5–10 large drops of blood are run in after the fluid. The lower chamber is heated and its capillary end is sealed off As the blood is drawn into the upper chamber its capillary end is sealed off. The tube is then shaken until the beads have defibrinated the blood which is then shaken into the lower chamber. The tube is then sealed off in the flame at the junction of the upper chamber with the connecting stem. The lower chamber can now be placed upright in the incubator at 37'c

To examine the culture the upper end of the tube is opened and a little of the surface layer of the deposit of blood cells is withdrawn with a Wright's pipette, and a smear is made and stained. The culture tube is immediately resealed in the flame and replaced in the incubator.

All the above steps are done with strict aseptic precautions.

Some very successful cultures have been obtained by this method.

Review of the position of the genus Haemocystidium 10(Castellani and Willey 1904) with a description of two new species.—*By* CAPTAIN H. E. SHORTT, I.M.S.

A paper designed to collect together the known facts from a variety of sources, as well from my own observations, regarding a genus (haemocystidium) a blood parasite of reptilia, which has special importance for workers generally on blood parasites of this type. One of the chief points raised is as to the identity of the genus Haemocystidium with haemoproteus.

Is Keratomalacia a deficiency disease ? if so, what is the nature of the deficiency ?—*By* MAJOR H. E. WRIGHT, I.M.S.

The clinical appearances were first described in detail. Briefly these consist in (*a*) eye changes, and (*b*) general constitutional changes. In the eye one may find a smoky discolouration of the conjunctiva with a greasy dryness and a concentric rippling, sometimes spoken of as Xerophthalmia. The cornea may show anything from a bluish haze of a diffused infiltration up to a dense opaque interstitial Keratitis, sometimes progressing to necrosis and ulceration. This is the Keratomalacia from which the condition derives its most common name. In addition there may be night blindness. The rate of occurrence amongst the out-patients at the Government Opthalmic Hospital, Madras, was about 0·4%. The tables give age distribution and frequency of prominent symptoms in 80 cases observed in 1921

TABLE I.

Age, Years.	Male.	Female	Total.
5 and under	27	21	48
5 to 15	9	10	19
Over 15	9	4	13
			60

TABLE II.

Condition.	Frequency.	Condition.	Frequency.
Liver.		Night blindness :—	12
Enlarged ..	7	Cornea :—Clear ..	1
Palpable ..	23	Steamy ..	11
Not Palpable ..	34		
Definitely small..	2	Deep infiltration ..	22
Not noted ..	14	Ulcerated	27
Jaundice :—		Not noted	9
General appearance :—		Conjunctiva :—	
Fat and healthy..	8		
Thin, not wasted	28	Epithelial Xerosis only ..	8
Marasmic ..	44		
		Xerosis with a smoky conjunctiva ..	61
		Apparently normal ..	11

Associated with the eye changes are (*b*) marasmus, intestinal disease, respiratory tract disease, liver disease (atrophic and hyperatrophic with or without jaundice), a trophic changes in skin and mucous membranes and bleaching of the hair.

Cases which showed night blindness alone or Xeropthalmia of a mild degree (referred to as Xerosis) were not considered in the above figures. There appears to be some connection between night blindness with or without Keratomalacia and night blindness with retinitis, whether of the "pigmentosa." "sine pigmento" or "Punctata albescens" variety. It may be that all those cases have causative features in common. The eye appearances were demonstrated by means of water-coloured paintings.

Is Keratomalacia due to a deficiency in Fat soluable A?

The experimental production of corneal necrosis by the deprivation of fat soluable A suggests that this food factor plays an important part in the human condition. It was not considered that the clinical condition was analogous to the experimental Keratomalacia of animals. In support of this view the different eye signs and symptoms in the two cases was quoted and the failure of human cases to respond rapidly to the administration of fat soluable A. Experimental observers lay stress on inflamatory conditions of the eye. Human Keratomalacia is a non-inflamatory condition. More accurate descriptions of the exact eye signs and symptoms in experimental Keratomalacia are required. In the experimental animals, according to Stephenson and Clarke, the determining factor of corneal implication appears to be bacterial invasion and the corneal condition an accident of infection in a pre-disposed eye. Just as in experimental work comparatively few of those who are predisposed to Keratomalacia actually develop corneal symptoms but bacterial invasion is not the determining factor.

The Keratitis of clinical Keratomalacia starts in the depth of the cornea while the epithelium and Bowman's membrane are still intact just as in certain cases of Syphilis or Tuberculosis the condition may run on as an interestitial Keratitis leading to dense leucomata without ulceration. Secondary infection by the flora of the conjunctival sac does not occur until the epithelium and Bowman's membrane are damaged. Experiments were carried out in the Government Opthalmic Hospital, with the idea of testing the value of introducing into the diet liberal amounts of ghee, fruit juice, meat juice, and whole egg without Cod liver oil. This did not produce as good or better results as Cod liver oil alone and neither produced the rapid effects obtainable in experimental animals. *It may not be the fat soluable A in Cod liver oil which is all important.* Fresh liver feeding has been practised with success on the west coast for years in this condition. No matter what the determining factor in Keratomalacia may be it is certain that the influence of *insufficiency of diet in general predisposes to the disease.* To quote from the text of the paper:—

"It would be impossible to give a correct impression of Kertamalacia as seen here without drawing attention to the population from which our cases are derived and to the manner in which its individual members strive to exist on a minimum of food."

"In Southern India, the bulk of the poorer classes are always in, what McCollum terms the "Twilight Zone," where small shifts in the quality of the diet with respect to any factor determine a pathogenic state. Not only is this so as regards fat soluable A but also as regards other vitamines and the optimum ratios of food principles in general."

It would be premature in the present state of our knowledge to place the blame on any one food factor; but that unsuitable and insufficient food plays a very important part in all the degenerative states which are met with in hospital practice,—and predisposes to this condition seems undoubted considering the large number of predisposed persons only a very small percentage develops any of the symptoms of Keratomalacia.

But there are other considerations. If a dietetic deficiency is admitted, it may be determined at three leaves, (*a*) the food supply (mentioned above), (*b*) the absorbing area, (*c*) the mechanism whereby the absorbed material entering the portal circulation is modified for tissue use The second consideration (*b*) is very important. Failure at this level is predisposed to by (*a*). Many cases show an alimentary disorder, but some do not; it is therefore not absolutely essential. As regards (*c*) the paper may be quoted in original:—

"The association between a liver affection and the reminder of the, picture of Keratomalacia in a large number of cases is undoubted. It does not appear to matter so much what the type of the liver defect is, provided the functions of the organ are interfered with. Thus we find the typical eye symptoms with syphilitic cirrhosis, intestinal toxic cirrhosis, malignant disease. It may be that some hitherto unknown function of the liver is disturbed by the mere fact of a local lesion, but if this were sufficient in itself to determine Keratomalacia, one would expect it to be far more common."

The liver defect may be merely a sector in the vicious circle of defects at levels (*a*), (*b*) and (*c*), so powerfully productive of clinical Keratomalacia.

With regard to the role of the liver the question was asked, "is there an internal secretion of the liver or is one of the great metabolic functions disordered as for instance the normal metabolism of the fats?

"As far as I am aware there has not up to the present been a case made out for an internal secretion of the liver in the same sense as for the testis or pancreas. Still when one considers that of all the glands of the body the liver has more influence on the metabolism of food stuffs and fulfills more diverse functions than any other gland, it would not be surprising if another role were added to its repertoir. One feels a perfect maze when one considers the extraordinary diverse actions of this gland on the different classes of food stuffs as they reach it direct from the absorption surface. How these functions are carried out is still a very dark chapter in medical science. May it not be that there is an internal secretion and that this internal secretion is in certain quantity essential McCarrison has drawn attention to the sequence, defective diet, damaged alimentary canal and abnormal endocrine function. Hepatic function is surely affected and is of prime importance"

The author then stated the desirability of further human experimental work and chemical research in this connection and expressed his intention of utilising liver extract in the ensuing year in the treatment of his cases. At present patients are being treated by fresh liver feeding.

Finally the opinion was expressed that the condition of Keratomalacia was one in which an organism primarily subjected to the effects of a diet unsuitable, insufficient and deficient in accessory factors, secondarily sustaining a damage to the absorbing surfaces, finally develops a specialised degeneration, frequently associated with a liver failure, the nature of which is obscure.

Rhinosporidium kincalyi.—*By* MAJOR WRIGHT, I.M.S. *and* DR. TRIMURTHI (Madras).

This protozoon was discovered by O'Kinealy of Calcutta in 1903 in yascular pedunculated nasal polypi and described by Vaughan, Professor of Pathology at the Medical College of the City.

In 1905 Minchin and Fantham published an exhaustive description of the minute structure of the parasite, and in the same year late Dr. Nair of Madras drew attention of the profession to its existence in this Presidency. In 1906 Beatty published a detailed microscopical description of the sporozoon. The discovery of the parasite in other situations than the nose belongs to Kirkpatrick and Ingram, formerly of the Pathological Department of the Madras College, who in the year 1909 demonstrated the presence of the parasites in a conjunctival polypus and in a papillomatous growth of the penis respectively. Later Elliot recorded a case of Rhinosporidial growth of the eye lids. In 1914, the reader published an account of the parasite with the clinical notes of 15 cases. In 1920, Mr. Chinnaswamy Pillai observed the parasite in a papillomatous growth of the uvula. The first case of Rhinosporidium of the lachry malsac was recorded by Kirkpatrick in 1916. Further observations on Rhinosporidium of the conjunctiva and the lachrymal sac have been made by Wright and his articles on the subject will shortly appear in the medical press.

The nature of the local lesion was dealt with. In the nose Rhinosporidial growths are soft, vascular and polypoid or papillomatous. The growths are reddish in colour, very friable and bleed readily. They are attached to the nasal mucous membrane by narrow pedicles. The globular appearance of the ordinary nasal polypus is absent; the Rhinosporidial polypi appear to be flattened out. The growths of the conjunctiva were likened to small portions of the spleen or lung of a small mammal with a slightly granular surface. Water coloured paintings of Wright's cases were shown.

In the lachrymal sac the parasite gives rise to reddish soft polypoid growths which fill up its cavity. The sac has a granular feel. The parasitic polypi can be seen only when the sac is removed and cut into. Associated with the growth is a suppurative dacryocystitis. Photographs of the conditions were shown.

The microscopical appearances were described in detail and some sections shown on the screen of a minute conjunctival polypi 2 mm. × 1 mm. A reference was made to the probable mode of infection. Up to the present animal inoculation has proved negative. Batton and Ingram tried planting small portions of polypi, subcutaneously with negative results. Wright and Cunningham placed small portions of growth into sub-conjunctival pockets in monkeys and also tried vaccination on the penis, and nasal mucosa of monkeys with emulsion of fresh polypus and injection of similar emulsion into the lung. These experiments were unsuccessful up to the time of writing. The above experimentors apparently assumed that direct transfer was possible. The reader was of the opinion that direct transfer from man to man is the mode of transmission. Wright considered that the position of the local lesion suggests dust or water transmission and that the spores when shed probably have an extra human life cycle before gaining access to the human mucosa.

In this connection it is interesting to note—

1. So far no case has been described in a female
2. In the Madras Presidency individuals from the West Coast appear to be more frequently affected.
3. The majority of sufferers are boys and young adults, the highest incidence being between 10 to 20 and 20 to 30.

Treatment. Up to recently removal of the growths was the method productive of the greatest success. When the growth was localised and easily accessible as in the conjunctiva, this was successful. In the nose, however, recurrence was the rule. Kirkpatrick advocated the use of quinine solution in treating conjunctival case. Wright tried the efficacy of Quinine Bi hydrochloride in 1% and 2% water solution on a conjunctival polypus without success. He found in one case that 2% Tartar emetic dropped into the eye t i.d., caused the disappearance of the polypi in two months. Presumably the tartarated antimony destroyed the parasite. This observation needs confirmation.

Treatment of Leprosy with hydnocarpus oil and its preparations.—*By* E. MUIR.

Hydnocarpus oil is derived from the seeds of hydnocarpus wightiana. There are some 28 species containing more or less of the same qualities, which make them useful in leprosy.

The Ethyl and Methyl esters of the fatty acids have been found the most useful forms for administering the drug and they may be given in doses up to 12 or 15 c.c. per week by a combination of intramuscular and intravenous injections.

The initial doses must be small, but in order to maintain improvement it is necessary to increase the dosage. The increased dosage generally results in a reaction which is followed by increased tolerance and larger doses have to be given.

In our experience better results are obtained by this line of treatment than by any other drugs, but it is necessary to bear in mind that diet, climate, exercise and many other matters, have to be attended to if the patient is to recover.

Note on the preparation of vaccine lymph effective in a tropical climate.—*By* LT.-COL. W. F. HARVEY, I.M.S.

An exposition of Dr. Nyland's method of preservation of potency of vaccine lymph under continuously tropical conditions.

The principle underlying Dr. Nyland's method is that no vaccinifer shall be inoculated with lymph derived from the same species of animal.

Under these conditions degeneration does not take place. Three species of vaccinifers are used, the rabbit to provide lymph for inoculation of the cow-calf and the cow-calf to provide stock lymph for inoculation of buffaloes. The buffaloes thus provide the lymph which is used by the vaccinators in the field. This lymph can be issued by ordinary post, and can be sent far afield without loss of potency. It is diluted at the time of use by the vaccinator and this diluted lymph preserves its potency for two or three days.

The necessity for a standard for vaccine lymph.—*By* MAJOR J. CUNNINGHAM, I.M.S., *and* MAJOR J. A. CRUICKSHANK, I.M.S.

Various standards have been introduced from time to time but none of these have come into common use. Vaccine lymph has been considered satisfactory so long as continuous vesiculation has been obtained. Variations in potency and the possibility of deterioration cannot be judged to any extent by this means. A more exact determination of the value of a lymph is thus required.

The authors describe a method which depends upon the dilution of the lymph to various strengths until discrete vesiculation is obtained. The results are recorded in terms of the number of vesicles and the yield of pulp per linear inch sown. The compartive value of various samples of lymph can thus be recorded.

An examination into the degree of efficacy of Antirabic treatment.—*By* LT.-COL. HARVEY, I.M.S. *and* MAJOR H. W. ACTON, I.M.S.

The statistical argument adopted by the authors leads to the following conclusions :—

(1) The crude death rates from rabies whether amongst treated or untreated should be corrected in accordance with the constitution of the population concerned.

(2) We should have substitution or at least inclusion of the total mortality rates in reports, which at present simply give failure rates.

(3) The current ideas of the mortality occurring amongst the untreated are in need of revision.

Cholera and the value of prophylactic inoculation.—*By* MAJOR H. G. STILES WEBB, I.M.S.

Deals with the experience of the author whilst working in the districts of the North-West Frontier Province at cholera during the months of April-September 1921.

He deals briefly with the vibrios that have been found in connection with cholera and how they can obtain a footing in the human body and their ultimate fate there.

He next touches on the subject of immunity as regards cholera, and finally gives his experience of inoculation as recommended to be practised at present, and his reasons for modifying the dosage to meet conditions attendant upon treating an epidemic in a widely distributed population when cholera was epidemic.

The following doses of cholera vaccine were employed by him.

Series 1. A single dose of 0·5 c c. (4000 M. Vibrios)
,, 2. ,, 1·0 c.c. (8000 M. ,,)
,, 3. ,, 1·5 c.c.
,, 4. Two doses 1st 0·5 c.c. and 2nd 1·0 c.c.

He gives a series of cases of cholera occurring in 88 inoculated persons and wishes to hear if his experience is verified by other workers.

The 84 fatal cases which were inoculated occurred in three of the series as follows :—

Series I	Cases.	Deaths.	
	16	5	Mortality
Series II	Cases.	Deaths.	25%
	51	12	
Series IV	Cases.	Deaths.	
	21	7	33%

No case occurred in Series III.

The author summarises his conclusions as follows :—

"In the first place I have had no case of cholera occurring up to date in any individual who received a single dose of 1·5 c c. of more, and I think this justifies me in concluding that for district work at any rate, the larger single does is essential to success. I am prepared to admit that this probably won't protect every case, but I think it would protect a larger number of individuals, than any smaller dose, or 1·5 c.c. in two successive doses would.

I had no ill effects whatever from giving the larger dose, and experienced none myself.

I should hazard the opinion that a first dose of 1 c c. followed in 10 days by one of 2 c.c. would be the ideal produce, but I had no opportunity of trying it in the district work.

I am now very firmly convinced of the value of inoculation and I will admit that when I started I was somewhat sceptical "

The dose of prophylactic vaccine necessary in re-inoculation.—*By* LT.-COL. W. F. HARVEY, I.M.S.

The author records experiments which tend towards the conclusion that dosage in prophylactic re-inoculation need not be as large as those used on first inoculation.

Observations on the incidence of cholera in the individual districts in the Madras Presidency.—*By* MAJOR A. J. H. RUSSELL, I.M.S.

This paper gave the results of a preliminary investigation made within recent months. In an attempt to throw light on some of the problems connected with the prevention of cholera, maps of the Presidency indicating the areas affected by the south west and north-east monsoons were prepared and these showed that, roughly speaking, the Presidency could be divided into two areas, first, the northern area covered by the south-west monsoon and second, the southern area covered by the north-east monsoon. Average monthly cholera death rates for each district for the twenty years ending 1920 were also prepared and the figures obtained were plotted out in the form of graphs. Three distinct types of curve were obtained.

In the northern area affected by the south-west monsoon, the curve for each district reached its maximum in July or August and then gradually fell to the normal figure. In some districts the maximum was much more evident than in others but was nevertheless quite distinctive in all the districts lying to the north of the spur of the Eastern Ghauts.

The characteristic of the southern districts was the increasing incidence of cholera 1–2 months after the commencement of the north-east monsoon, the maximum being reached either in December or January. The spasmodic shower falling as a result of the influence of the south-west monsoon were not sufficient to produce any very appre ciable effect and cholera outbreaks in June to September were therefore brief and not very intense. Those districts lying round Madras City and those in the south of the Presidency adjoining the Bay of Bengal, and the Arabian sea all presented the typical curve with a high maximum in December and January, falling to a small minimum throughout the rest of the year.

The south-western interior districts were represented by curves showing a double rise—the curve being a combination of the types already described. These districts have a very meagre rainfall, and are usually almost entirely unaffected by the south-west monsoon. Cholera begins to increase shortly after the north-west monsoon bursts and the curve of the graphs rises abruptly to its maximum in December and January. The curve of South Canara District which, on the above distribution, ought to correspond to the first group, was found to be very similar to that of the third group and although suggestions were made as to the cause for this disparity of type, no definite conclusion was arrived at and the matter is receiving further attention.

Further investigations were proposed on a possible relationship between humidity and the incidence of cholera on the lines indicated in Col. Gill's paper on the influence of humidity and temperature on the incidence of malaria.

A plea for the extended use of the Voges Proskaver reaction.—*By* Lt.-Col. Glen Liston, I.M.S. *and* S N. Gore.

1. Among the biochemical reactions of lactose-fermenting organisms of the "Typhoid colon" group, Indole and Voges Proskauer reactions stand pre-eminent. It is therefore essential that the techniques of such routine reactions should be simple, rapid and reliable. Such a technique has already been described for Indole, viz. the "Cotton-wool-plug test" but none of the methods so far recommended for performing the Voges Proskauer reaction fulfills the conditions of a routine test.

2. Accordingly we have developed a technique which conforms to the requirements of a routine test. Our procedure is as follows:—The culture is inoculated in nutrient broth containing one per cent of the glucose and at the end of every twenty-four hours period of incubation a loopful of the culture is removed on white porcelain slab and mixed a loopful of a forty per cent solution of caustic soda. In the case of a positive Voges-Proskauer reaction a distinct pink colour develops in about five minutes, and if no pink appears in ten minutes the result is taken as negative. In a large majority of positive cultures we have found that twenty-four hours' incubation sufficies and it is only in a few cases that further incubation is required.

3. In the glucose broth, the pink colour of the V.P. reaction attains its maximum in about ten to fifteen minutes but fades away almost completely in about one hour. We have shown that if milk be used instead of broth for the glucose medium, not only a brighter pink colouration is obtained but the mixture of the culture and soda solution solidifies and forms a dry pink spot on the slab which retains the intensity of the colour for more than six hours. In certain instances we have observed that when saccharose is used in place of glucose in the culture media, a positive V.P. reaction appears after a shorter period of incubation, and the pink colour is brighter than in glucose media.

The inapplicability of the Mills-Reincke phenomenon to Indian conditions.—*By* T. N S Raghavachari.

The applicability of the Mills-Reincke phenomenon to the vital statistics of any town with a protected water supply depends upon four essential conditions.

(*a*) The existence of a definite water-borne disease with an appreciable mortality.

(*b*) An accurate record of the total death rate.

(*c*) An accurate record of the death rate due to certain individual diseases, both water-borne and non-water-borne.

(*d*) The existence of a fully protected water supply.

This paper deals with the extent to which each of these factors is present under Indian conditions.

The first condition is amply satisfied by the presence of cholera in endemic form.

The second is in all probability sufficiently accurate in many municipalities to meet the case.

The third is at present unattainable.

The fourth is also open to serious doubt, for the term " protected " as applied to water supplies in the Madras Presidency can only be regarded as relative and in most cases does not come up to the standard required for a successful application of the phenomenon.

Limitations of B. Coli method in water examinations.—*By* RAO SAHIB V. GOVINDARAJU.

Contradictory opinions are at present held on the subject of bacterial standards of purity of water in India. My recent researches tend to throw some light on some of the causes of this divergence of opinion. The presence of frogs in water has been found to be responsible for an increase in faecal bacilli which though negligible in the case of ordinary waters is apt to be misleading in the case of waters of great purity like mountain spring waters Again stasis in reservoirs and passage through pipes may be responsible for an increase in faecal bacilli, so that a mere increase in the number of faecal bacilli, in a water does not necessarily indicate faecal contamination but may simply be due to stasis in reservoirs or to flow through pipes.

The Sack Steam Disinfector.—*By* MAJOR L. A. P. ANDERSON, I.M.S.

A new type of disinfector devised by Col. P. S. Lelean, Professor of Hygiene at the R.A.M. College, called the " Sack Steam Disinfector," was brought to the notice of the Indian Science Congress by the author.

The special features claimed for this apparatus are that it combines at a low initial cost, simplicity of construction, portability, high working efficiency and general utility for both civil and military use.

This type of disinfector has also been elaborated into different types for use under varying circumstances.

The disinfector is very simple in construction and consists essentially of a steam tight sack 2′ by 4½′ of 13 cubic feet capacity the base of which is connected by hose to a small 8 gallon boiler. The method of working it is also equally simple and depends on the displacement by steam of the heavier air contained in the sack. The water filling pipe of the boiler is arranged in such a way that it permits water to escape.

Should the boiler pressure exceed 13″ water head, the emission of steam through the pipe gives warning that the boiler requires replenishing. This forms a very simple and yet effective safety valve requiring no skilled attention for its supervision. Tests carried out in England prove the efficiency of the disinfector as a germicide. A disinfector of this type would be of special value in schools, municipalities, hospitals, and institutes especially in the mofussil, ships, labour camps, pilgrim centres, etc.

Some observations on the trenching of night soil.—*By* JAHAR LAL DAS

The paper records the observations of the author on the trenching of night soil at Maniktala, a first class municipal town with a population of 53, 763 (1911) and only a limited acreage (30 bighas) available for trenching. The instructions laid down in the Circular issued by the Sanitary Commissioner for Bengal in 1909, enjoined, amongst other things that a trenching ground should be divided into three plots and each plot should be trenched once in 3 years, i.e. trenching in first year and cultivation for two years with a view to prevent the land from becoming sewage sick. Calculated on the basis of this Circular, the total extent of land for the purpose at least 200 bighas of land would have been required. Consequent on the limitation thus set up, the author decided on re-trenching every plot, every few months, after examining them as to their fitness for retrenching. He found that in a ripe (repeatedly) trenched soil it took nearly five but never less than four months for the transformation of the excreta into a sort of odourless loose black earth, irrespective of weather conditions and whereas in a virgin soil it took about three months more for the excreta to acquire this character. Thus every plot was retrenched about half a dozen times instead of once, every three years.

These observations were fully borne out at other places adjoining Calcutta, viz. Nadi Bagan, Howrah, Cossipore, Chitpore Municipality and also in other parts of Bengal.

He concludes that:—

(1) The nitrifying organisms in the soil multiply enormously after the application of human excreta and the soil gets improved in quality to such an extent that it can be re-trenched more often than the period originally laid down.

(2) No soil was found to disintegrate in less than four to five months.

(3) The soil did not appear to become sewage sick.

(4) Except from an economical point of view, the idea that cultivation is necessary is not based on any substantial evidence.

(5) By not reapplying night soil to any plot for about two years the plot may acquire more or less the characteristics of virgin soil by the death of the nitrifying bacteria as a result of starvation.

(6) Hard clayey soil when retrenched at short intervals improves in quality and acquires a porous character suitable for trenching.

Sewage disposal with use of gases for generating electricity and of the effluent for agriculture.—*By* K. BURJORJI DADYBURJOY.

The present method of sewage disposal in Indian towns is defective and uneconomical. Septic tank treatment of sewage and disposal of residue on land for sewage farming have been tried in a few places but concerted attempts have been made to utilise to the best advantage the gases which emanate from the septic tanks and which are bound to be a source of great nuisance. These gases can be collected and burnt in gas engines for generating electricity to be used for lighting a town and other trade purposes. This paper records a method whereby any town in India can have a good sewerage system together with an efficient and cheap installation for producing electricity. An ideal airtight septic tank is described as also the method whereby the gases collected within the roof over the septic tank are drawn by suction into a gas holder by its combination with a specially constructed purifier, consisting of a box containing slaked lime which effectively removes the CO_2.

These gases can be conveniently and directly used for lighting purposes the Matunga and Greaves cotton mills at Bombay and Raja Gokuldoss mills at Jubbulpore are successful examples of this. The gases can also be profitably used for working a gas engine to drive dynamos for generating electricity.

The sewage effluent and gases after treatment have been found to be odourless.

The conditions necessary for such a process of sewage disposal are as follows :—

(1) The sewerage system must be a separate and not a combined system.
(2) There should be no open house drains where the household rubbish and other foreign substances enter the sewers.
(3) There should be as little silt or foreign substances as possible in the sewage. The provision of "Natrani" traps so as to prevent the entry of these into the sewers, is advocated.
(4) There should be no obstruction by intercepting sewer traps in the flow of sewage in sewers, as these are responsible for a loss of over 25% of the gases *en route*.
(5) Factory waste should not be allowed to enter into the sewers, without being treated chemically by precipitants.
(6) Proper supervision of the sewerage system is essential and should be directed towards effectively preventing the ingress of silt in excess into the sewers.
(7) The gas installation should be properly supervised.
(8) The sewage should reach the septic tank in as pure a condition and as quickly as possible.

Section of Anthropology.

President :—Rai Bahadur Hiralal, B A . M.R.A.S.

Presidential Address.

THE ABORIGINES OF CENTRAL INDIA.

The most wonderful thing in this year's programme is the Chairman of the Anthropological Section of the Science Congress. In such a conference one would expect a scientific man to preside, but in the Anthropological Section, one from a most unscientific class the district officer, has been selected This was the first problem which confronted me, when I first heard of it, but I have found a solution to what appeared irreconcilable in the beginning. The Executive Committee were wise in interposing something dark between two stars in order to prevent overlapping of their brilliance. You know my predecessor Rai Bahadur Sarat Chandra Roy, who, in the words of so great an authority as Sir Edward Gait "knows far more of the subject than any one else in India," and I hope, my successor will be a rival of Mr. Roy. In that case, a dark interposition, as you will admit, was very necessary You will have, therefore, no cause to be disappointed if you find no light and no science in what I am going to read to you about some of the Central Indian Tribes.

It has become a fashion to talk of various waves of immigrations from which the teeming millions of India derive their origin. This is probably due to the fact that the dominating race of Aryans are immigrants and as they came from outside, they have fallen into the habit of thinking that their predecessors did the same. They have, therefore, been at pains to discover from various data, Geological, Archæological, Linguistic and Anthropometrical, when their predecessors in the remotest antiquity came over to patronise this land. The primitive races are taken back to some period when they are alleged to have come to this country from somewhere else. Geologists tell us that the Indian Peninsula was formerly cut off from the north of Asia by sea, while a land connection existed on the one side with Madagascar and on the other with the Malay Archipelago, and the inference drawn by some scholars is that the oldest known inhabitants of India came here from those places. There is linguistic affinity between the Mundari languages and those of the Indo-Pacific Islands and the Malay Peninsula. Thus the theory of immigration suits the propounders thereof very well, and they have no hesitation in putting forward that the Munda or Kolarian tribes entered India from south-east Again they find Brahuis a tribe in Baluchistan speaking a language akin to Oraon from which they conclude that the Dravidians entered India from North-West. But no reason has been shown why the reverse should not have been the case. If India had autochthones why could they not emigrate to Baluchistan, Malay Peninsula and the Indo-Pacific Islands? I have not yet come across any cognet reason to suppose that India was barren and wholly colonised from outside. As a matter of fact there are several reasons to regard the Dravidians as children of the soil. Says Sir George Grierson, "The Dravidian languages form an isolated group. Comparative philologists agree that the Munda languages, Khassi, Monkhmer, Nancowry and the speech of the aboriginal races of the Malay Peninsula contain a common sub-structure which cannot be any thing else than the language of an old race which was once settled in all those countries. No traces of that common stock can be shown to exist in the Dravidian forms of speech and from a philological point of view it therefore seems probable that the Dravidian languages are derived from the speech of an aboriginal Dravidian population of Southern India, while the Dravidian race at some remote period has received an admixture of tribes belonging to the same stock as the Monkhmers of Farther India. The Dravidian race is not found outside India." It is true that the Australians share many of the characteristics of the Dravidians, but there are not sufficient reasons to assimilate them into one common stock. The question of the origin and old distribution of the Dravidian race belongs as remarked by Sir George Grierson to the domain of anthropology and of anthropology alone. This science has, however, developed very little in India and it is only recently that it has been taken up in right earnest in some quarters. And the most important problem to be solved by it is whether the Dravidians are autochthones. Sir Herbert Risley has introduced a confusion in the racial terminology of this country by including all Mundari-speaking people into Dravidian which was formerly restricted to people speaking Tamilian and kindred languages. In fact Tamilian is a mere variant of Dravidian and I think it is best to continue to use the word in its old sense, since Risley's theory of racial distribution has not been universally accepted. The well-known Dravidian tribes number about a crore as against a crore and a quarter belonging to the Kolarian or Munda races. These do not include castes formed by fusion with later immigrants such as the Aryans or those wholly absorbed by Hinduism. The aborigines apparently had no regular tribes as is evident from their names which are merely equivalents of 'man' in their languages, as distinguished from other animals For instance, those calling themselves Korku derive the name from Kor a 'Man,' ku being the plural suffix. Similarly the biggest tribe in Central India is named Gond, but in its own language its name is Koitur which means 'man.' By the way it may be remarked that the Aryans being the dominant race, went so far as to impose contemptuous names on the wild people which, at any rate in the case of bigger tribes, gained currency over the proper tribal names. The name Gond is one of that class and is derived from Sanskrit meaning an ox or cattle, Gonds being regarded as no better than cattle. As a matter of fact in certain localities they are still regarded as such. How the subject people submitted to the effrontery of the dominant class is exhibited by a curious incident in my own experience. Some years ago when making ethnographic enquiries in the Bamra State, I asked the Kharias to come up before me, and a number of people immediately separated from the rest of the assembly composed of several aboriginal tribes To answer a question put by me they consulted each other talking in their own language which I recognized to be Oraon I immediately queried "you say you are Kharias but you speak Oran." And the reply was "yes, we are really Oraons and speak our language Oraon, but the Uriyas (meaning Orissa Hindus) call us Kharias and we are therefore obliged to call ourselves Kharias in order to prevent misunderstanding as they apply the name Oraon to Kharias." The Kharias were also present on the spot and corroborated the story of the so-called Kharias they themselves answering to the name of Oraon, though they admitted to me that they were really Kharias. Thus the primitive people have not only accepted opprobrious names, the etymology of which they did not know, but have even condescended to yield to the whims of their superiors in accepting wrong names imposed on them by the ignorance of the dominant class.

As is well known, the tribes have not escaped the influence of Hindu caste system which has resulted in the formation of a number of sub-tribes which in several cases have matured into full blown Hindu castes, and have broken off their connection with the parent stock so far, that they cannot now be recognized as having had any connection with the tribe from which they sprang.' As remarked by a Census Superintendent 'in the stupendous growth the base and the main trunk have in several cases been altogether lost sight of so that it is now by no means easy either to distinguish the branch from the trunk and the twig, or to locate the root of any trunk, branch or twig.' In spite of this, a number of tribes have persisted in retaining their original characteristics.

According to the Census statistics the biggest tribe that has withstood the procession of centuries is that of Gonds. Its present habitat is Central India, which once bore the name of Gondwana after the tribe. According to the Census of 1911, Gonds numbered 29 lacs, but the figure is not reliable as some two lacs of the same tribe in the United Provinces have been separately classified under a name spelt as GONṚ as distinguished from GOND. But this is a distinction without a difference. Again certain sub-tribes have been separately classified, for instance, the Koi, the Gowari, the Pardhan and the Parja, which in previous censuses had been included under Gonds. These 4 sub-tribes muster six lacs strong, so that the total number of Gonds goes up to 37 lacs which represents the highest tribal strength in India exceeding even that of Kolis who are now absorbed into Hinduism and who according to Census tables number close upon 32 lacs, otherwise the highest figure for any tribe in India, even after excluding 3½ lacs of Kols from whom Kolis are said to be derived. The fact, however, remains that on the Dravidian side the Gonds and on the Kolarian side the Kols are the strongest being almost equal in number each exceeding 30 lacs. Both these tribes are found north of the Godavari, though the former's origin is traced to the country south of that river. It is somewhat curious that in the true Dravid country, viz. south of the Godavari, there should not be found a Dravidian tribe as strong in numbers as the Gonds of Central India. The Central Province is full of Gonds. Every 7th man there is a Gond. There are certain hilly districts where as much as 60 per cent of the population is Gond.

There are altogether some 40 different tribes in Central India, of which about ⅘ths do not individually own a strength of even 50 thousand persons. Thus we are left with about nine great tribes, viz. Gonds and Oraons belonging to the Dravidian group and Bhils, Kawars, Korkus, Kols, Sawars, Binjhwars and Bharias included amongst Kolarians. In point of strength the Dravidians as exhibited by these tribes far outweigh the Kolarians, the former numbering 30 lacs against 15 of the latter. It is note-worthy that the Kolarians have much more assimilated with the Hindus than the Dravidians. In fact it is very difficult to differentiate Kawars, Binjhwars, Sawars and Bharias from low caste Hindus. These people have absolutely lost their languages, if they had any, and their manners and customs have undergone great changes. In Central India even Kols have forgotten their languages which is preserved by their brethren in Chutiya Nagpur. Thus it is only Korkus amongst the main tribes of Kolarians who speak their primitive tongue. On the other hand the two main tribes of Dravidians mentioned above have retained their languages even in the remotest corners True, there are thousands of Gonds who speak only Hindi. And yet the persistence with which the primitive tongue has held its own in the midst of very unfavourable surroundings goes to show that languages die hard and are the best index of the tribal unity, if not identity.

I will now try to give you a glimpse of these nine Central Indian tribes, and leave you to judge where they should find their place in the distribution of Indian races. I will begin with Gonds as they are important from various points of view —their numerical strength, their primitive character and the share they took in the political history of the Central Provinces for about 3 or 4 centuries. One would expect that their ascendancy as rulers of the country must have been in the remote antiquity when they were monarch of all they surveyed and their right there was none to dispute, but this is not so. They ruled the province in comparatively recent times after the 14th century A.D. one of their queens, the famous Durgavati of Garha Mandla, having opposed and fought the Great Akbar. The original ancestor of the ruling family appears to have migrated from south of the Godavari. This has led some writers to believe that the whole Gond population came from that quarter. But the advent of the ruling family dates back to 14th century. Surely three million Gonds did not start at once in order to strike the great Kalachuris of Tripuri in their own homes and oust them for their audacity in raiding their country again and again during the period immediately preceding the exodus. In fact the first-ancestor of the ruling family, according to tradition, was a mere adventurer and got the throne through luck. The king of the Jubbulpore country having no male issue was advised to leave the selection of his successor to Divine will and for this purpose a blue jay was released. The bird alighted on the head of one Jadorai, a stranger from south of the Godavari and the king gave him his daughter and kingdom. Even the beginning of the Christian era when the Andhras from the South overran Central India is too late a date for the immigration of the Gonds from the south of the Godavari. It is possible that during the Andhra ascendancy some Dravidian families may have settled in Central India These may well have been Gonds, but this is not sufficient to account for their presence there in such force as mentioned before. That Gonds have been for ages in Central India is testified to, by even mountains, rivers and valleys which bear names taken from their aboriginal tongue. For instance, in the northernmost districts Saugor, Damoh and Jubbulpore, where Gondi has practically disappeared, we find such villages as Rengajhari, Mahka Kohka, Ami, Murukuru, Tumripar. Surekha. etc., all derived from Gondi words for various kinds of trees. In the same tracts may be traced names of mountains and rivers derived from the Gondi language, for instance, Kaimur, Bhander, Kenjua, etc., among hills and the Umrar, the Bhamrar, the Simrar, the Paphrar, the Nibar, the Kulhar and several other rivers all with the suffix *ar* derived from *er*, Gondi for water. Toponymy is of great value in a matter like this but I do not find any serious effort made to study it properly. According to the legendary account of the original of the tribe, the Gonds emanated from Kachi-kopa Lohagarh or the Iron Valley in the red hill which is located in the Central Provinces at Pachmarhi, whose striking hill scenery and red soil cleft by many deep inaccessible ravines render it a likely place for the incident. Capable observers have described the physical appearance of Gonds as having well proportioned bodies but rather ugly features. They have a roundish head, distended nostrils, wide mouth, thick lips, straight black hair and scanty beard and moustache The Gond women differ among themselves more than the men. In the open tracts many of them are great robust creatures, finer animals by far than the men. In the interior again bevies of Gond women may be seen who are more like monkeys than human beings. The features of all are strongly marked and coarse. Gond men as tall as Hindus and more strongly built and with comparative well-cut features are now frequently seen, though the somewhat broad nose is still characteristic of the tribe as a whole This would be perhaps put down as a very unscientific description of the physical type, but there has been no anthropometrical survey in the Central Provinces to enable one to give precisely the cephalic or nasal index which is the order of the day. And let me here interpose a remark about the reliability of anthropometry in the case of Indian people. Of the three main methods applied for distinguishing between the races of mankind, viz. physical, cultural and linguistic, the first named is considered as the most satisfactory basis on which a classification of mankind can be erected. Skin, colour, hair, stature, nose, face and head-form are the chief factors constituting physical characters for classification. Anthropometry chiefly comes in for head-form and nose, which in India are rendered artificial by the prevailing manners and customs. There is a wide spread custom of moulding the head and nose according to notions of supposed beauty. Walcher has shown that in infancy the bones of the skull are so soft that it can be made longer or broader according as the child lies on its side or its back. What then, when midwives actually manipulate with the head and nose to put them in proper order? In the western Punjab it is the almost universal practice to flatten the back of a baby's head by making it lie on its back with its head resting an a hard surface. A very detailed and interesting account of this practice is given in the Baluchistan Census report, where it is stated to be extremely common. It is not less common in Central India though the Gond midwives do not seem to be partial to aquiline nose. They make the head all the same though they may not touch the nose. Nearly all people including Hindus do the same, the matter being at the mercy of the midwives' notions of beauty. Among the Hindus the pulling of the nose to make it aquiline is very common, which renders the nose test as of little scientific value. On the Madras side, however, the custom of making the head and the nose has not been heard of, and one may expect some sort of uniformity, but Thurston tells us there is none. This result cannot but be disappointing.

To return to our Gond, let us now look to his dress. There was a time within the memory of living men, when in certain hilly tracts they went quite naked. It was local officers who compelled them to use small strips of cloth and the Gonds were obliged to do it as the officers would not allow them to visit bazars in a state of nature. They commenced by putting on the strips for the period they were inside the bazar and then depositing them on a tree while returning home, but later on they got accustomed to a whole-time wear. A Gond's dress even-now continues to be very simple. A rag on the loins and another on the head complete his costume. These are really substitutes for leaves, bark or skin formerly used to cover nudity in the one case, and for bark or creeper band in the other to keep the hair in its place, when shaving or cutting the hair was not practised Of course the dress varies according to the stages of development the Gonds have undergone in various places In the towns they may be found as fully dressed as any Aryan high caste. The ornaments of the jungle tribes as a rule consist of bead garlands and tinsel of sort, and so are the Gonds. Gonds live in mud houses or huts made of bamboos plastered with mud with thatched roofs. The household articles consist of earthen pots for cooking and keeping water and for distilling liquor, which is now prohibited, a few gourds for cooling water, grinding mills, contrivances for extracting oil and husking grain, leaf plates and cups, ladles, baskets, bins, pipes, mats, brooms and a few odd things. Fire drill is now seldom used and has been replaced by the chakmak (steel and flint). Their favourite mode of agriculture was the burning of forest and showing the seed in the ashes without any ploughing operation, but this is now prohibited by Government. Their peculiar hunting appliance is Dhatti. To one end of a stick an earthen pot with a wide hole is attached and to the other a basket of faggots Fire is kindled in the earthen pot and a noise with rings is made. This is done in the night. The wild animals come dancing drawn by the light and the jingling noise made with the rings. A second man armed with a bamboo strikes the animal as they approach the Dhatti. Gonds have many kinds of traps and snares, and use also bows and arrows, and lances and spears for hunting. They surround a tiger and spear him, Their food is simple. In the wilder tracts they live in roots and fruits and flesh of wild animals. Wild mice are a delicacy to them, and sometimes a penalty for tribal offences is levied in the form of so many mice to be provided by the offender for a tribal feast. The principal amusement of Gonds is the dances in which both males and females take part. They have a peculiar sustaining power and would sometimes dance the whole night and again be ready to do so if called on. A marriage ceremony is the greatest occasion for it.

The present internal structure of the tribe shows that Gonds have contributed a number of occupational groups, such as the Agarias or iron workers, the Gowaris or graziers the Ojhas or soothsayers, the Pardhans or priests and minstrels, the Solahas or carpenters and the Koilabhutis or dancers or prostitutes. There are a number of others, which form endogamous divisions and are on the way to complete separation like the occupational groups.

The Gond rules of exogamy vary in different parts and in one respect resemble the system found in Australia, by which the whole tribe is split into two or four divisions and every man in one or two of them must marry a woman in the other one or two. This is considered by Sir James Frazer to be the beginning of exogamy by which marriage was prohibited first between brothers and sisters and then between parents and children by the arrangement of these main divisions. The Gond septs are totemistic. People with different totems may not intermarry, if they worship the same number of gods. The system in certain localities is, however, very complex.

The marriage is adult and pre-nuptial license is allowed, especially in a Gotal Ghar, which almost every village possesses. It is a house where unmarried boys and girls dance and sleep The Oraons also have a similar house and we learn from Professor Haddon that Papuans also possess an analogous institution. Almost every where in a village, he informs us there is one building often two, of a public character where men eat and spend their time. In these young men sleep and strangers are entertained. The Gond marriage is a simple ceremony. Its distinctive feature is that the procession starts from the bride's house and the marriage is held at that of the bridegroom, quite the reverse of what is prevalent amongst the Hindus. Survivals of the custom of marriage by capture are to be found in many localities. A bride price is paid. The practice of Lamsena or serving for a wife is commonly adopted by boys who cannot afford to buy one. Traces of matriarchate are found in the custom of marrying the brother's daughter to the sister's son, which was done for bringing the latter as an heir to his house. Now-a-days the marriage of brother's son with sister's daughter is very much in vogue. in fact it is claimed and admitted as a right on the ground that the brother's family gave a girl to the other family and the latter was therefore bound to return a girl to the other family. This is called *Dudh lautana* or bringing in back the milk. Widow marriage, divorce and polygamy are freely allowed. The last is reckoned as a sign of wealth and dignity and is sometimes made an exhibition of. A Gond in Balaghat who had seven wives was accustomed always to take them to the bazar walking in a line behind him

The Gonds bury their dead. They deify them and worship a host of gods of whom Pedda Pen or Bura Deo stands at the head. He lives on a Saj tree (Boswellia serrata). The Gonds were accustomed to human sacrifices and hook-swinging, but cannibalism was unknown.

As a rule Gonds are simple-minded, shy, quiet, docile and honest. 'They are a pleasant people and leave kindly memories on those who have to do with them. Comparatively truthful, always ready for a laugh, familiar with the paths and animals and fruits of the forest, lazy cultivators on their own account, but good farm-servants under supervision, they are the fit inhabitants of the hilly and jungly tracts in which they are found.' In the wilder tracts, the Gonds used to fly at the approach of strangers and in some parts they had great fear of a horse. As a class they are very ignorant. I have seen some Gonds who refused to accept copper coin eight times in value than the cowries they wanted in exchange for an arrow. A gentleman relates that he once sent a basket of mangoes to Bhadrachalam, warning the Gond carriers not to eat any of the fruit, as it would be known from a note placed in the basket. On the way, however, they were overcome by the attraction of the fruit and decided that if they buried the note it would be unable to see them eating. They accordingly did so and ate some of the mangoes, and when taxed with their dishonesty at the journey's end, could not understand how the note could have known of their eating when it had not seen them.

This brief account of Gonds may give you some little idea of the great Central Indian tribe, whose ancestors during the 16th century lorded it over a province somewhat larger than the British isles and almost equal to Japan. In the words of a Settlement Officer of a district where they had one of their capitals, "the Gonds left a well-governed and contented kingdom adorned with admirable works of engineering skill and prosperous to a point which no after-time has reached (in those localities). They have left their mark behind them in royal tombs, lakes and palaces, but most of all in the seven miles of battlemented stone wall at Chanda and strong forts at various places" In the Tribes and Castes of the Central Provinces, some 124 pages have been given to the description of Gonds, but they deserve a separate monograph which still remains to be written.

I now come to the Oraons, on whom a very interesting monograph has been written by that unselfish worker, who is doing so much for Indian Anthropology, I mean, Rai Bahadur Saratchandra Roy. As you know, he hails from Ranchi, the headquarters of Chutiya Nagpur where Oraons abound. In the Central Provinces they are merely an out-growth numbering only 83,000 against their total strength of over 7 lacs in India, yet in Central India they form the second Dravidian tribe very appropriately, as they are so closely associated with Gonds. Mr. Roy identifies them as the monkeys who formed the armies of Rama. The Oraons in their own language call themselves Kuṛukhs, the derivation of which is unknown. It may be derived from some word meaning 'man,' but on that account we cannot go to any sort of root, which may yield that meaning, as Dr. Hahn seems to suggest. In his opinion Kuṛukh may be identified with the Kolarian Koro or Horo, man, but this cannot be admissible in as much as no tribe would go to another to get its name from it. The tribal name must naturally come from the original language of the tribe itself. A number of scholars have tried to trace the etymology of both the names, but none of their conjectures appears to be satisfactory. I quote them here simply to show how fancy works in such matters, as it has done in the case of tracing the origin of the Indian people, without bringing conviction home. Let me, however, first tell you that this tribe owns some six different names, viz Dhāngaṛ, Kūḍa, Moḍi and Kisān besides Oraon and Kuṛukh. Dhāngaṛ means a farm servant, and this name is given to them where they serve as such. Elsewhere they are diggers of earth and therefore called Kūḍa which means a digger. In some places they make a speciality of constructing embankments of fields and are called Moḍi from Mūḍa an embankment.. Where they cultivate for themselves they are known as Kisan, which means a cultivator. As regards the most prevalent name Oraon, some derive it from Aryan and others from aboriginal languages. Dr. Hahn was the first to derive it from Orgorā̃, a hawk, which is a totemistic sept of the tribe, and he thought this was the name given them by the Hindus. Sir George Grierson suggested an improvement, saying it might be derived from the Burgandi ūrāṅg 'men.' This may be plausible, but no tribe as stated before would go to borrow a word from another language for its name. If it wanted to call itself a collection of men, why could it not take a word from the language it was using? Mr. Roy is of opinion that Oraon is a corruption of an uncomplimentary name given to them by the Hindus as Rawanput or born of the demon Rawana. The original word was in due course abbreviated into Rawan vulgo Rawanā, which with an interjection O assumed the form of Oravana or Oraon. Here let me add that Gonds are known as Rawanbansi or descended from Rawana, but they seem to have escaped an appellation derived from that suggestive source. Oraons are known to spend what they get, and some therefore derive the name from *uṛāna* to spend. Some say they owe their name to an agricultural operation, *ūṛna*. to pour seed through the tube of the sowing plough or from their partiality to *aruā* a kind of rice. Again it is suggested that as they bend very low while saluting, they received the name from Hindi *uramnā* to bend. Yet another derivation is suggested from *urai*, the khas plant, which the Oraons plant on the grave of their dead. Others again very plausibly suggest that since they were stupid and ignorant they were nicknamed Oraon from Arua an Owl. Since it is no disgrace to err in the company of savants, I have also ventured to add a derivation of my own, assuming that Mr. Roy's theory that the Oraons were Vānars or monkeys of Rama's army is admissible. I see no difficulty why Vānar should not have assumed the present form of their name. From Vānar the word Vanrā̃o would simply be a form meaning "monkey like." Vanrā̃o may change into Unrāon, leading finally to Ũrao. Now let us consider the name they use among themselves. As stated before, Dr. Hahn would derive Kuṛuk͟h from the Kolarian horo man or the Dravidoscythian Kuṛuk͟h a cryer. Dr. Grierson does not support this view and remarks that a people may call themselves speakers but not cryers. Mr. Roy finds a Sanskrit origin for it from Krishāṇ changed into Krikhāṇ, Krikhāḍ and thence Kuṛuk͟h. Some say Kuruk͟hs came from Konkan and that gave them the name. Others say their colour is black and they were, therefore, nicknamed Kṛishṇatwach, which corrupted into Kuṛuk͟h. Another derivation is from Tamil Ḳaṛugu, an eagle, which is a totemistic sept and yet another from 'Kurk͟hi' a fence, referring to their making fences for fields, as part of their agricultural work, According to their own story, the Kurukhs derive their name from Karakh the name of their first king, who ruled over Karush or Karukh country, the old name of Shahabad District whence they say they emigrated. It is very probable that their tribal name is a territorial one, derived from the country from whence they migrated. But this postulates another primitive name, since they say they went to Shahabad from the Karnatak, where they must have had some other name which is now lost.

Oraons resemble the Gonds in many respects. Both are hard drinkers and great dancers, both are Māndar and Chaṭkora players using double faced drums and castanets, both have Gotalghars or Dhumkurias for their bachelors and maids already described, both have the same sort of beliefs and ceremonies and both are hilarious and light hearted, with no cares to trouble them They resemble in features also and the Oraon language is decidedly Dravidian The most marked feature of the language is its guttural intonation. One gets startled at *Ḳḥer*, *Ḳhaddar*, *Ḳhalli*. *Kḥisse Kḥer*, *Kḥikha Kḥibda*, *Kḥes*, *Kḥann* but amongst the wilder Gonds the Gondi is of the same type. We hear a Maria or hill Gond saying ‘ Baghe Oroq Mānenā irur Maq Mattur,” while the same sentence would be spoken by a Gond of the plains as “ Bore Orur Mannena irur mark mantur.” In Mr. Roy's monograph interesting features of the tribe have been brought forth and they need not be mentioned, but there is one speciality worth notice. There are traces of marriages between a grandfather and a granddaughter, which so far as I know, have not been detected in other Indian tribes. But it is said to prevail amongst the aborigines of Australia and the Island of Pentecost.

Besides the two great Dravidian tribes, there are about ten others whose total strength in Central India does not exceed 1½ lacs Amongst these the most important are Kandhs or Khonds. whose total strength in India is about 7 lacs, out of whom only about 10,000 live in the south-east corner of the Central Provinces. Their habitat is the hills of Orissa and Ganjam District, the tract which they once ruled. They have been very notorious for human sacrifices.

A special interest attaches to a local tribe found only in the south-western portion of the Central Provinces and no where else. It is called Kolam. Its speech bears some interesting points of analogy with the Toda dialect of the Nilgiris. Sir George Grierson is of opinion that from a philological point of view, the Kolams must be considered as the remnants of an old Dravidian tribe, who have not been involved in the development of the principal Dravidian languages or of a tribe who have not originally spoken a Dravidian form of speech. A curious practice prevailed amongst them of capturing husbands for women, who would otherwise have gone unwedded, this being apparently a survival of the matriarchate. Widows and widowers were exempted from capture and debarred from capturing. The total number of Kolams does not exceed 25,000. The rear of the Dravidians is brought up by three Chenchus apparently casual visitors from the Hyderabad State. A Census Superintendent playfully tells us " He who would enumerate the Chenchus of the Nallamalai forest must needs first catch them. And a Chenchu possesses some remarkable faculties, among them the faculty of seeing things and of disappearing before things seen. Lie hidden behind a bush and watch a group of Chenchus crossing a forest clearing; stir a finger and the Chenchus are not, it is as though the earth had swallowed them up."

To return to our seven Kolarian tribes, the Kols and Bhils are most important in this group. The former are found to the east and the latter to the west of the province, and both have imbibed Hindu manners and customs, Bhils having forgotten their language altogether, while the Kols have preserved theirs only in the locality whence they have migrated, viz. Chutiya Nagpur. Some Bhils have even become Musalmans, but they were forcibly converted by Aurangzeb. These latter have, however, formed a community of their own, and have preserved some of their primitive customs. They do not freely mix with other Musalmans. Bhils seem to have attracted the attention of the Aryans much earlier than any other tribe, except perhaps the Savars, whose ancestors are sometimes spoken of as Bhils. Apparently Bhils and Savars were two branches of the same tribe descended from a common ancestor, Nishada, which is sometimes used as a synonym for Bhils, as they are called Venaputras, Nishada being the son of Venu.

Next in point of strength come Korkus and Kawars, the former speaking their primitive tongue, while the latter have altogether forgotten theirs. Korkus are certainly an off-shoot of Korwas and Kudakus of Chutiya Nagpur. They seem to have wandered away from their parental home in the north-eastern corner and settled in the very heart of the Dravidian people in the western portion of the Central Provinces. All these appear to have sprung from the common Kol stock, to which Ho, Munda and Santal bear a still closer resemblance. It appears that the Kawars, a polite form of Kawra, Kora or Kol are as closely related as the other tribes which have preserved their languages. So are Binjhwars and Bharias, the former deriving their name from the Vindhya mountains and the latter from the great Bhar tribe, of the United Provinces, about whom Mr. Crooke says that they were a race closely allied to Kols, Cheros and Seoris, who at an early date succumbed to the invading Aryans.

Thus out of the seven main Kolarian tribes of Central India, Bhils, Sawars, Kols and Bharias are known for certain to have been ruling tribes and Kawars and Binjhwars even at present own large landed estates. Only Korkus alone did not possess their own rāj, but they appear to be a later off-shoot from the parental stock which was dominant in Chutiya Nagpur.

I would now try to sum up the inference I have drawn from the study of these tribes in Central India, and submit to you for consideration whether they can stand the anthropological test Except Sir Herbert Risley, who denies any racial difference between Kolarians and Dravidians and the followers of his school, others have hitherto recognized three primary stocks in the Indian population, viz. the Kolarian, the Dravidian and the Aryan, and those who maintain that all the three came from outside, aver their immigration in the order named, Kolarians entering first from the south-east and sweeping over the whole of India, followed by the Dravidians from the North-West who drove the Kolarians to the hills and forests and were themselves finally hunted out by the Aryans to take refuge in similar places. In my view the Dravidians were the autochthones of the Indian Peninsula, even when it was cut off from the north of Asia by sea. and if the Kolarians were not the autochthones of the then South Asia or the present Upper India, they may have entered North India via Malay and Assam, and swept over Northern India. dominating it till they were ousted by the Aryans. This would explain the somewhat curious fact, why the Kolarian tribes who have forgotten their primitive tongue speak an Aryan dialect and never a Dravidian one. Had Kolarians been ousted by the Dravidians, some tribes at least would have yielded to the influence of the Dravidian dialects, but as they never came in contact with Dravidians, they could not but yield to the influence of their direct conqueror's speech, viz. the Aryan dialects. Professor Keane in his introduction to the Cochin Tribes and Castes states, that "in the first broad division between Aryans and Non-Aryans, the former were classed as Sud (Sudhan) that is the pure, the latter as Kol, the impure, literally swine, and by other uncomplimentary terms." I do not know whence this has been taken, but it seems to prove that the first tribes they encountered were those whom they named as Kols, and these must be those who still bear that name and its variants. How could the Dravidians who never received that name from the Aryans be included under that name? The tribes that came in contact with are Bhils, Sawars, Kols and Bhars, some of whom, if not all, find a mention in old Sanskrit literature, but there is no trace of a single Dravidian tribe having been defeated by the Aryans in Upper India. If Dravidians were successors of Kolarians, the Aryans should have certainly come in contact first with the Dravidians, and it is the Dravidians whom they would have called Kols and not the descendants of Australians who had been driven out of the field by the Dravidians. It is now partially admitted that Dravidians are an indigenous people and even Professor Haddon has opined that the Dravidians may have always been in India, yet the fact remains to be satisfactorily established by further researches

In the words of Professor Turner of the Benares University, the path to knowledge is laborious, the road is long and difficult. It calls for high endeavour and the nobility of sacrifice. But this reward awaits the traveller.

The origin of the Chinese junk and sampan.—*By* J. HORNELL

After comparing and describing the outstanding features of these two crafts, evidence is adduced in favour of the view that the sampan is derived ultimately from a modification of the double canoe in use till comparatively recently for sea work throughout Polynesia, and in a simple form still employed on inland waters in India, and that the junk is in turn a development of the sampan type, enlarged and adapted for deep sea trading. The truncate transom bow and stern of the sampan probably represent cross planking fitted between the bows and sterns respectively of the two canoes forming one double canoe, while the two projections that curve upward from the stern of the sampan appear to be the homologues of the upcurved sterns of the two hulls in the double-canoe form. In the same way the median rudder of the sampan and the junk and the achor platform that gives a square-bow appearance to the junk, are what would be expected if those crafts developed from two canoe hulls joined together by a planked deck-platform. Besides this structural evidence, we have the fact that the term 'junk,' derived proximately through the Dutch or Portuguese from the Javanese word *djong*, applied to large sea-going vessels of Chinese and Malay types, appears to be of the same origin as the terms used in Dravidian India for a double-canoe—*jangāla*, *changā dam* and *sangad*—; probably the Bengali *donga* has the same root. The *sangara* of the *Periplus*, described as large coasting vessels of South India, formed of monoxyla joined together, seem to have been more like the large double canoes of Polynesia than the small degenerate inland craft of the present day The facts point to the range of the sea-going double-canoe having extended in former days to India and China—the users and inventors being the ancestors of the present Polynesian race, who probably occupied the maritime districts of China at the time the Chinese left their original homeland in north-east Central Asia. The question is raised of the origin of the term *jangada* for the catamaran like sea-rafts used by the coasta native Brazilians. Is it indigenous or introduced by the Portuguese ?

Ethnography in Old Official Records.—*By* SARAT CHANDRA ROY.

In this paper the author emphasises the necessity of rescuing from neglect and impending decay, the many interesting scraps of ethnographical information contained in official despatches, reports, and other papers and bringing them within the reach of the student. He laments the indifference of the Government of the country and of most Indian Universities to anthropological science, and as a curious instance of such indifference he cites the omission of 'Anthropology' from the List of subjects prescribed for the Indian Civil Service Competitive Examination to be held in India in 1922, while Anthropology in its various branches of

Physical Anthropology, Prehistoric Archaeology and Technology, and Social Anthropology are included among the syllabus for the next Civil Service Examination to be held in England. The author suggests that the scope of the activities of the Indian Historical Records Commission might be usefully extended so as to include those of ethnographic interest as well. The author gives a few specimens of interesting ethnographic material buried in the moth-eaten records of Government record-rooms which he was able to unearth by the permission of the local authorities of the Chota-Nagpur Division.

Mala Anayans of the Travancoe Hills.—*By* RAO BAHADUR L. D. ANANTHAKRISHNA IYER.

Honey-gathering by the Hill Tribes.—*By* RAO BAHADUR L. K. ANANTHAKRISHNA IYER.

Prehistoric Archæology.—*By* PANCHANAN MITRA.

The rôle of climatic conditions in epidemic disease with special reference to malaria.—*By* LT.-COL C. A. GILL, I.M.S., D.P.H., D.T.M. & H., Chief Malaria Medical Officer, Punjab.

(1) *Historical Note.*

The nature of epidemicity has exercised the imagination of mankind since the earliest times and an important rôle in its mechanism has long been assigned to climatic and meteorological conditions.

In fact the association of plagues and pestilences with unusual climatic phenomena is one of the oldest epidemiological observations on record. It is not surprising therefore that with the birth of scientific medicine in ancient Greece the influence of climate on epidemic disease should early have attracted attention.

Hippocrates, over 2000 years ago, observing that a seasonal variation in the incidence of disease occurred in association with changes in climatic conditions and being impressed by the sudden and widespread nature of epidemic outbreaks, was led to conclude that a specific relationship existed between the outbreak of pestilence and atmospheric states.

Thus arose the miasmatic theory of epidemic causation which, as finally formulated by the Greek school of medical philosophers, postulated that all epidemic outbreaks were the result either of occult atmospheric states or of some change in the physical properties of air engendered by abnormal climatic conditions.

It does no small credit to the acumen of the classical school of epidemiologists that this theory with only minor modifications successfully held the field for over 2000 years. It is true that in certain respects its inadequacy became apparent, yet it was accepted in principle, if not in details by Sydenham and indeed by all epidemiologists down to quite recent times.

It was not in fact until after the discovery, in the latter half of the 19th century, of the micro-parasitic nature of infective diseases that the miasmatic hypothesis was finally and definitely abandoned. In the case of malaria this occurred about the year 1880, of cholera in 1884, of influenza in 1892 and of plague in 1894.

In the new impetus given to medical research by the great discoveries of the bacteriologists there was no room for the esoteric theories of the classical epidemiologists and the influence of climatic conditions on epidemic diseases was relegated to a position of purely classical interest

The subsequent discovery of the rôle played by insect and other "carriers" in the spread of human diseases merely served to confirm this view and to direct epidemiological research along fresh channels.

The new angle of vision from which epidemiological problems thus came to be envisaged is well reflected in the history of medical research in India. Up to about the year 1890 the valuable reports on great Indian epidemics, many of which may be found buried in official tomes, are replete which references to the rôle of climatic conditions, and many not altogether unsuccessful attempts were made (with the imperfect meteorological data then available) to correlate in true hippocratic fashion the outbreak of epidemics with specific atmospheric states.

But nowadays when, thanks to the records maintained by the Department presided over by Dr. Gilbert Walker, meteorological data extending over many years are available, epidemiological investigators usually omit all reference to the influence of climatic conditions or refer to it in a brief and perfunctory manner.

Nor does the rôle of climate in epidemic diseases fare any better in modern text-books in which this subject is dismissed in a paragraph whose brevity is rendered all the more conspicuous by reason of wide excursions into the domain of bacteriology, entomology and other ancillary sciences.

It is not suggested for one moment that modern investigators are ill-advised in concentrating attention on the micro organisms of disease and on the "carriers" of infection, nor is it desired to exaggerate the merits of the miasmatic hypothesis, but it is my object to emphasise the influence of the limatic factor in the mechanism of epidemic disease and to place before you some of the reasons for concluding that, this factor plays a rôle of profound importance in determining the occurrence of epidemic outbreaks.

(2). *The Influence of Climatic Conditions on the Transmission of Malaria.*

The subject-matter of the title of this paper is too extensive to be dealt with except in the briefest fashion. I propose therefore to consider the influence of climate on epidemic malaria with special reference to the rôle of certain meteorological conditions on the transmission of the disease. Thereafter the part played by the climatic factor in the case of other epidemic diseases will be touched upon and I will then conclude with some general remarks on the epidemiological problems whose solution is likely to be promoted by the study of the rôle of climatic and meteorological conditions.

It has long been known that malaria flourishes mainly in warm climates and in the hot season in the temperate zone, and it has been shown that this circumstance is, at any rate in part. dependent upon the fact that the malaria parasite ceases to undergo development in the mid-gut of anopheline mosquitoes when the temperature falls permanently below 16°C.

It has also been observed since classical times that high atmospheric humidity is favourable to the disease.

The epidemiological significance attaching to these facts has however attracted singularly little attention; only a few experiments have been recorded in regard to the influence of temperature, whilst the precise rôle of humidity has never been accurately determined. This apparent neglect, in the case of temperature, is probably due to the fact that its influence was regarded as being too obvious to require further elucidation, whilst in the case of humidity we have in recent years been obsessed by the view that high humidity favours malaria solely by its association with conditions giving rise to numerous breeding places of mosquitoes.

But it is surely inexpedient to adopt this view as expressing the whole truth, for in an insect-borne disease like malaria it seems *prima facie* possible—and even probable—that atmospheric states, by reason of their influence on the exogenous cycle of the malaria parasite and on the insect-carrier, will be capable of influencing the transmission of infection and thereby the incidence of the disease.

It was on these grounds thought expedient, in connexion with the study of epidemic malaria in the Punjab, to investigate the precise effect of meteorological conditions on the life-history of mosquitoes and on their power to transmit infection.

I need not detail the experiments undertaken with this object in view since they are described in the April number of the Indian Journal of Medical Research, but I must refer briefly to some of the conclusions to which they gave rise.

It was found that mosquitoes were extremely susceptible to the influence of humidity and that their length of life was largely determined by the relative humidity of the atmosphere. Thus, in the case of *Culex fatigans*, when adults are incubated at a relative humidity of 45 per cent or less (at a constant temperature of 27°C) they die within 5 days, whilst "controls" incubated under identical conditions but at a relative humidity of 48 per cent or over almost invariably survived for at least 10 days. Insects have in fact been kept alive in the laboratory under favourable conditions of temperature and humidity for nearly two months.

Other observations showed that relative humidity affected many of the habits of mosquitoes such as the selection of resting places during the heat of the day. It was also found, by means of controlled experiments, that at low degrees of relative humidity egg-development in fecundated females was retarded. Finally a high degree of relative humidity was found to be an important factor in determining the desire of mosquitoes to feed on blood.

A further series of experiments conducted with *Culex fatigans* infected with bird malaria (*Proteosoma grassi*) showed that batches of insects infected under identical conditions and incubated at the same temperature but at different degrees of relative humidity (between 48 and 100 per cent) all exhibited an identical degree of infection, as measured by the number of oöcysts developing in the mid-gut. It was also found that the shortest period required for the completion of the developmental cycle of this parasite in the mosquito was six days.

These experiments therefore point to the conclusion that, whilst relative humidity may exercise an important influence in determining the transmission of malaria by reason of its effect on the longevity of mosquitoes, it does not exert any direct effect on the malaria parasite during its exogenous cycle.

On the other hand observations on the influence of temperatur show that low temperature (in the presence of high relative humidity) has little effect on the length of life of mosquitoes although low temperature, as in hibernation, temporarily restricts their vital functions. But temperature exerts a marked influence on the malarial oöcyst, since development ceases when the temperature falls permanently below 16°C, whilst its rate of development (within certain limits) is known to vary directly with the height of the temperature above this figure

These observations therefore suggest that the climatic factors of temperature and humidity are both capable, though in a different manner of influencing the transmission of malaria. Now these meteorological elements are negatively correlated in Nature so that a marked rise in temperature is usually associated with a corresponding decline in atmospheric humidity and *vice versa*.

A fall in mean temperature may thus give rise to atmospheric conditions favourable to the prolonged life of mosquitoes but incompatible with the transmission of malaria owing to an unfavourable temperature.

On the other hand when the mean temperature undergoes a marked rise the relative humidity is apt to fall below the "critical" figure. In such circumstances mosquitoes may be prevalent and active but the transmission of malaria will remain in abeyance since infected insects will not live long enough to transmit infection.

These facts, I think, point to the conclusion that considerable importance attaches to the study of meteorological conditions in relation to the transmission of malaria and indeed of all insect-borne diseases.

They afford also a scientific basis for the hypothesis of Galen (to whom malaria was well known) that "the seeds of pestilence," which he regarded as floating in the air, required for their propagation "a warm and moist state of the atmosphere."

(3). *The Role of Climatic Conditions in the Mechanism of Epidemic Malaria.*

When the meteorological circumstances necessary for the transmission of malaria are considered in the light of the climatic conditions prevailing in the Punjab some interesting facts emerge.

It is found, at the result of a study of the temperature and humidity data given in the Meteorological Reports, that the transmission of malaria is in abeyance during the cold weather on account of low temperature.

During the spring there is normally a short period during which both temperature and humidity are favourable to infection. With the rise in mean temperature which ushers in the hot weather the transmission of infection is again interrupted owing to low mean relative humidity.

With the onset of the monsoon a marked rise in relative humidity takes place and both the temperature and humidity factors become favourable to the transmission of infection.

In average years the annual period of potential infection is found to be approximately 4 months in most parts of the plains, but in years of deficient monsoon rainfall it is much less as it is apt to be interrupted during "breaks" in the monsoon. On the other hand in years of excessive rainfall the meteorological factors remain highly favourable to the transmission of infection throughout the monsoon period.

It is in these latter years alone that great epidemics of malaria occur in the Punjab, but even then they do not involve all parts of the Province nor do they occur in areas where the rainfall is relatively or absolutely in excess. It is in fact found that malaria epidemics are strictly confined to areas exhibiting climatic conditions which, whilst usually relatively unfavourable to the transmission of infection, become highly favourable to infection and re-infection on rare occasions.

This epidemiological observation accounts for the fact that great epidemics of malaria are not encountered in all malarious countries but are only met with in areas exhibiting climatic conditions similar to those characteristic of the plains of the Punjab.

Climatic circumstances therefore constitute an exceedingly important factor in determining the locale of epidemics of malaria.

Climatic conditions also determine the occurrence of these epidemics during the period immediately following the rainy season.

The seasonal periodicity of malaria epidemics is thus a function of the climatic factor.

The role assigned to temperature and humidity in favouring the transmission of malaria suggests that the well-known association of excessive rainfall with epidemic malaria may best be explained as being due to an *indirect influence of rainfall on atmospheric humidity* rather than to the effect of rainfall in creating breeding grounds of mosquitoes.

Finally, it is clear that, since excessive rainfall is an essential precursor of an epidemic of malaria, *this climatic factor constitutes the direct and immediate cause of an epidemic.*

These conclusions, if well-founded, suffice to show that climatic influences are intimately concerned in the mechanism of epidemic malaria. They are also not without importance from the practical point of view. Thus it is now possible with the aid of meteorological data to determine with some degree of precision the period during which prophylactic measures, such as the use of mosquito nets, are necessary in any given area.

Finally, with a knowledge of the climatic and other factors concerned in the mechanism of epidemic malaria, it should become possible to forecast the occurrence of an epidemic several weeks before its onset. A recent attempt on these lines was attended with highly promising results and it may well be that the time is not far distant when "epidemic forecasts" will become a normal function of the modern epidemiologist.

(4). *Conclusion.*

The views briefly advanced in this paper suffice, I think, to suggest that climate exercises a marked influence in the causation of malaria epidemics.

It is of course not the only factor concerned in the mechanism of epidemicity but it seems justifiable to conclude that climatic conditions constitute a factor whose importance it is both inexpedient to neglect and difficult to over-rate.

Time does not permit of the consideration of the possible rôle of climate in the causation of other epidemic diseases, and it must suffice to state that whilst little or no precise knowledge appears to exist on the subject, it is not unreasonable to assume that the climatic factor will be found to exercise an analogous influence in the mechanism of many epidemic diseases. In the case of plague, for example, it was shown by the Plague Research Commission that the severity of plague epidemics in the Punjab during each spring was closely associated with excessive humidity during the four months preceding their occurrence, and it was concluded that this circumstance was due to the favourable effect of humidity on the life-history of rat fleas.

But no experiments appear to have been carried out to determine the precise influence of humidity on the rat-flea or indeed on any of the other "carriers" of human disease.

An exception to this statement are some observations of Kinghorn and Yorke (1912) on the influence of temperature and humidity on the developmental cycle of *Trypanosoma rhodesiense* in *Glossina morsitans*,

These observers reached conclusions strikingly similar to those detailed in connexion with the transmission of malaria by mosquitoes although they recorded no observations on the influence of meteorological factors on the life-history of tse-tse flies.

These observations therefore suffice to emphasise the view that our knowledge of many insect-borne diseases will not be complete until the influence of meteorological conditions on their transmission has been determined.

Nor is it expedient to assume that climatic conditions only exercise an influence in diseases spread by means of an insect-carrier, for it is clear that all pathogenic parasites are exposed to the influence of meteorological conditions during their extra-corporeal existence.

There would appear therefore to be few epidemic diseases, not excluding cholera, in which the influence of the climatic factor can be safely disregarded. Little or nothing appears to be known in regard to the influence of climate on directly-transmitted epidemic disease, but I hope to show in a paper now under preparation the manner in which the climatic factor is involved in the mechanism of epidemic influenza.

With these remarks I will conclude in the hope that sufficient has been said to justify the view that the study of climate in relation to epidemic diseases provides a wide field of investigation whose prosecution is calculated to throw fresh light on the mechanism of epidemicity and thus lead to the discovery of new methods of prevention.

Recent work on the Constitution of the Atom.—*By* E. P. HARRISON, Ph.D , F.R.S.E., F. Inst. P.

To penetrate the mystery of the constitution of matter has been and still is the primary goal of the Natural Philosopher. Enormous advances in knowledge of the atom have occurred since Dalton propounded the Atomic Theory, but most of this advance has taken place in the past two decades; it may therefore be useful if I set before you a very brief account of how matters stood about 15 years ago, at the beginning of what the historian would call the " present " period.

At that time, the Cathode rays, which really form the starting point of the whole story, had been proved to be "particles" carrying a definite charge of negative electricity and moving with a speed about $\frac{1}{10}$th of that of light.

It had become abundantly clear that the negative electron, as such a "particle" was appropriately called, was a common constituent of all known forms of matter, that its charge was always the same ($4{\cdot}8 \times 10^{-10}$ electrostatic units) and that its mass (7×10^{-28} gram) which was regarded as being due wholly to its charge, and residing in the " field ' surrounding it, increased as its speed increased

These characteristics of the negative electron were, on the whole, truly experimental discoveries standing independent of those underlying hypotheses which have subsequently enabled the properties of a moving electrical charge to be worked out theoretically on the basis of Maxwell's electromagnetic equations.

At the time these discoveries were in progress, it was realized that knowledge regarding positive electricity was practically nil. Certain phenomena had, indeed been observed and investigated concerning the existence behind the cathode in a highly exhausted tube (under the influence of the electric discharge) of undoubted positively charged atoms or molecules, but interest in these experiments was swamped by the prevailing fascinations of the minute negative carrier. The positive particles appeared to be exceedingly massive compared with the negative electrons.

Having made certain of the existence of a common negatively charged constituent of matter which was apparently universal and which always possessed the same properties; remembering also that the 90 known elements differ in respect of the properties of their *atoms*, the logical conclusion was that the electron was a sub-atomic entity. It was recognized for example that an electron from a carbon atom might quite happily replace an electron from an iron atom ; so far as observable properties go, no change was to be expected either in the carbon or the iron.

On that foundation the serious problem of theoretical atom-building which now occupies so much of the physicists' time and thought had its first beginnings. The problem, 15 years ago, was in this form :

given these universal negatively charged electrons and some knowledge of their properties,

given the fact that positive charges were at least occasionally associated with matter in atomic form,

given also the principles of dynamics and the Maxwell equations (already established abundantly),

construct an atom which as a first approximation must fulfil the following conditions :—

(1) In its various complexities it must explain the Periodic law and the sequence of atomic weights.

(2) Its oscillations must account for radiation, that is for spectral lines, sharp and diffuse and for spectral series and for the Zeeman effect.

(3) It must account for the main facts of chemical combination and valency of the elements.

(4) It must explain the phenomena of magnetism in so far as that may be an atomic property.

The most successful attempt at a synthesis of the atom, about this time, was due partly to Lord Kelvin, but subsequently and chiefly to Sir Joseph Thomson. This model assumed a sphere of + electrification of atomic dimensions in which rings of electrons were immersed. The latter were conceived not to be at rest, but to revolve in orbits under the influence of the central attractive force provided by the sphere. Electrons in static equilibrium, not revolving would largely fail to account for magnetic phenomena, which on a theory of this kind involves the magnetic fields produced by electrons moving in an orbit. The conditions of stability of the Thomson model fixed the arrangement and number of rings of rotating electrons which were possible for a given total number of electrons, the total number being regarded as proportional to the atomic weight. When stable arrangements were worked out, it was evident that atoms so formed which possessed similar internal ring structure—and would therefore be expected to show similar chemical properties—recurred periodically as the atomic weight (total number of electrons) increased. Thus condition (i) was fulfilled. The main facts of the variation of valency among the elements were also accounted for. Moreover, by considering the changes in period of rotation of an electron in its orbit a general outline of the phenomena of radiation and of the Zeeman effect was provided, while the resultant magnetic moment required for a ferromagnetic atom was also explained by matter built up of the Thomson atoms. In looking at the great complexity of the material properties which any atom model ought to account for it is hardly surprising that these early synthetic atoms should fail along certain lines Indeed it is extraordinary that they accounted for so much and this indicated that research was at least on the right track

The main objections to the Thomson model are that the mechanism of this type of coplanar ring atom appears incapable of explaining the simple relationships between spectral series still less the extremely complex spectra and series of lines which are known by observation. Indeed, as I shall point out presently it was considerations of this nature which later formed the starting point of a completely new design in atom architecture.

It is also difficult to account for the ejection of an α particle in radioactive change. But above all, the objection to the Thomson atom lies in its failure to account for the mass of the structure The electromagnetic mass of the electrons forms a negligible part of the whole observed mass of the atom (3×10^{-26}) while the electro-magnetic mass of the positively charged sphere is far smaller even than that of a single electron. Whence then does the mass of the atom arise ? The Thomson model gives no account of this.

About the time that the Thomson atom was being elaborated the first faint suggestions were being heard that perhaps after all the motion of the ultimate constituents of matter did not occur under the old dynamical laws. The ideas were heretical in the extreme, and were largely rejected as curiosities by the average physicist. I shall attempt to show later how fruitfully these suggestions have developed in the last few years.

Meanwhile the attack on the mystery of the atom has continued to develop along two main lines.

The first, by observing and classifying the automatic records of the atomic vibrations as shown in (*a*) spectra and spectral series and in thermal radiation; (*b*) X-ray emission from elements ;(*c*) Radio activity; and then attempting to build up an atom, which fits the facts. Unfortunately it is quite impossible to work backwards and to infer from the spectra or other phenomena what kind of atom to start with. The only way to do that is apparently by direct frontal attack on atom structure by bombarding matter with high velocity projectiles in the form of α particles from radium C, and observing—

(*a*) what happens to the projectiles,
(*b*) what happens to the bombarded atom.

This may be described as the second line of attack. I will first consider what has been done by Rutherford and Marsden by the bombardment method the experiments beginning about 1910.

The principal of the experimental method is that each individual α particle gives rise to a scintillation when it strikes a screen of zinc sulphide crystals.

From radioactive experiments it had been proved that the α particle was a helium atom which had lost two electrons, probably external ones and therefore possessed a charge $+2e$. As it had only lost two electrons it clearly possessed practically all the mass of the original helium atom and was regarded as being the + portion of the atom. Its velocity from radium C was known to be about 2×10^9 cms/$_{\text{sec.}}$ =12000 miles/second. If a steam of these high velocity, massive particles is fired at a thin plate of matter such as a film of gold, their behaviour on emerging from the film, can be examined by a Zn sulphide screen held at a suitable distance. We might have expected the particles even if they penetrated the film to be enormously scattered during the process. One would, at least expect this result if he regarded the positive or massive parts of the bombarded atom to be of size comparable with the α particles. It was however found by Geiger and Marsden that the large majority of the α particles were very slightly deflected from their original direction, but that occasionally an α particle suffered a large deflection. In rare instances a particle was deflected more than 90°. Now it is not difficult to show that the deflecting effect of the negative electrons is negligible; so also would be the effect of a distribution of + electricity over a sphere as imagined by Thomson. Consequently it must be inferred that the massive part of the atom associated with the + electricity is concentrated in an exceedingly small region, for if not the deflections of the α particles must have been both large and numerous. If we call this minute massive portion the *nucleus* of the atom, detailed calculation (based on the inverse square law of electrostatic action and taking the known masses and charges of the α particle and bombarded nucleus) agreed extremely well with the deflections actually observed and also brought out two additional points:—

1. The large deflections were due to a *single encounter* and not to a number of small deflections superposed.
2. The colliding particles in the case of the large deflections approached one another within a distance of 10^{-12} cms.

The good agreement of theory and experiment thus afforded very strong evidence that the inverse square law was true down to the distances of 10^{-12} cms. from the nucleus, and that the + charge of the latter was distributed over an exceedingly minute region of space.

The most recent work of Rutherford is even more sensational.

It was found that the passage of α particles through hydrogen gas gave rise to scintillations on a screen placed far beyond the range of the particles itself, four times as far in fact. The natural explanation appeared to be that the *hydrogen atom* or part of it was shot forward by the collision. It was found, as the result of experiment.

1. That the atoms, whatever they might consist of, were propelled in the direction in which the α particle was moving
2. That the velocities were distributed over a small range, i.e. they all had nearly the same velocity.
3. That the nuclii approached within a distance of 3×10^{-13} cms. during a collision. Now Darwin has obtained an expression for the num-

ber of long range atoms of charge $+e$ to be expected as a result of collisions with bombarding α particles of charge $+2e$ *assuming the nuclii act as point charges under the inverse square law.*

The number observed experimentally does not agree with Darwin's calculations. It is much greater than theory indicates. There are three possible explanations :—

Either (i) the assumed charges $+e$ and $+2e$ are wrong.

Or (ii) the nuclii do not act as point charges but as structures of finite size,

(iii) the law of force is wrong at these small distances.

If α particles of smaller range (4 cms.) and smaller velocity are used the Darwin law for number is much more nearly obeyed. Thus in these cases both Darwin's assumptions as to the charges and the force-law must be correct or very nearly so.

In other words when the approach of the nuclii is not so close the charges and the law of force are correct and the nuclii act as points. Hence it is concluded that for the closer approach of the swifter α particles (range 7) the most likely solution is not that the law of force itself suddenly alters but that the nuclii no longer act as point charges at distances of 10^{-13} cms.

It is interesting to realize how very few α particles come into collision with H atoms. Only one in 100,000 of α particles in 1 cm. of H at N. T. P. give a swift atom Each α particle passes through the sphere of action of 10,000 H molecules in its flight through 1 cm. of H gas.

It has also been shown by Rutherford that the H nucleus behaves as an independent unit and swift H particles as produced equally well from combined hydrogen.

Additional confirmation that these swift atoms are really hydrogen with a + charge has been obtained by the measurement of their mass and velocity by the deflection method.

They are found to be atoms of

charge $+1$

mass 1 relative to oxygen (mass 16)

and the value for $\frac{\text{charge}}{\text{mass}} = 10^4$ e.m. units. The electrolytic value of $\frac{\text{charge}}{\text{mass}}$ for H, is 9570 e.m.u. Hence the atoms are undoubtedly hydrogen of charge $+1$ which means that they are probably hydrogen nuclii.

It may be that the positive nucleus of hydrogen is in reality the + electron, or *proton* with purely electromagnetic mass. If this is true it is easy to calculate its diameter since its mass and charge are known.

Thus if M and m are the masses of nucleus and negative electron respectively, both being purely electro-magnetic ; R and r their respective radii. Then since they have the same charge e (by hypothesis).

$$\left.\begin{aligned} R &= \frac{2}{3}\,\frac{e^2}{M} \\ r &= \frac{2}{3}\,\frac{e^2}{m} \end{aligned}\right. \quad \therefore \quad R = \frac{m}{M}\cdot r = \frac{1}{1830} \times 1{\cdot}5 \times 10^{-13} = 10^{-16} \text{ cms.}$$

Thus on this hypothesis the radius of the H atom nucleus is $\frac{1}{2000}$ of the radius of the negative electron.

Its extreme minuteness is borne out as we have seen by all the deflection experiments

Since the Helium nucleus (α particles) has nearly four times the mass of the H nucleus it is inferred that the former contains four positive electrons (H nuclei) and two negative electrons associated very closely. Thus its net charge is $+2e$. Since in radioactive transformations, α particles are produced but never H atoms, it is further inferred that the combination of H nuclii with 2 – electrons to make an *a* particle is extremely stable.

The experiments on scattering, for heavy atoms like gold show that the nuclii behave as points down to distances of 3×10^{-12} cms. whereas the H experiments indicate that the law *fails* to hold down to 3×10^{-13} cms.

We thus begin to get some distortion of the nuclii produced by the intense forces when they approach to within this latter distance of each other. The calculated value of the repulsive force between two nuclii on a close approach of this kind is 5 *kilograms wt* !

The most recent discoveries resulted from some experiments on the absorption of the propelled hydrogen atoms by gases.

When columns of Oxygen or CO_2 were used the absorption followed the usual law. When however dried air was used the number of scintillations increased instead of diminishing.

Now *a* particles in Oxygen and Nitrogen give rise to atoms of range 9 cms. in air and are probably swift Oxygen or Nitrogen atoms carrying unit charge and produced by collisions. Therefore in the experiments now being described only those atoms were dealt with which were propelled with ranges greater than 9 cms.

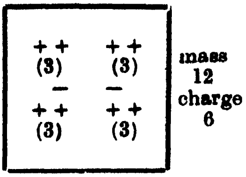
These long range atoms from air were proved not to be due to Hydrogen from water vapour nor were they due to Hydrogen impurities or to H atoms from dust nuclii in the air neither was there any change in the phenomenon when chemically prepared Nitrogen was substituted for air. As they were not produced in Oxygen it was necessary to attribute them to Nitrogen. But Nitrogen atoms have only a range of 9 cms., so the new particles cannot be Nitrogen itself.

The value of their mass and velocity was determined by the deflection method and yielded strong evidence that the atoms in question were Hydrogen. Further comparisons of the deflection of known Hydrogen atoms with the new atoms amply confirmed this The only conclusion remaining is that the Nitrogen nucleus itself is disrupted by the collision, and that charged Hydrogen nuclii are knocked out. It is calculated that only one *a* particle in 300,000 can approach the Nitrogen nucleus near enough to liberate Hydrogen atoms with enough energy to be detected. Many may however, be liberated with smaller velocities and absorbed before reaching the screen.

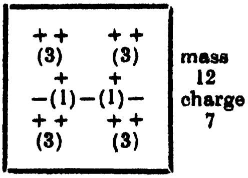
In addition to the long range atoms from Nitrogen with which I have just dealt there are produced atoms of shorter range but still greater than that of the *a* particle which produces them.

There is strong experimental evidence for believing these short range atoms from Nitrogen and also from Oxygen to be atoms of mass 3. They are produced in greater numbers than the H atoms. It is therefore suggested that a group of mass 3 is a regular constituent of the nuclii of both Nitrogen and Oxygen. Thus the Nitrogen nucleus can be disintegrated either by the expulsion of an H atom of charge +1 or by the expulsion of an atom of mass 3 carrying 2 charges. It is therefore an isotope of Helium.

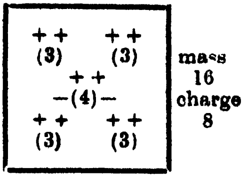
A possible structure of Carbon, Nitrogen and Oxygen atoms is suggested by Rutherford as a result of these recent experiments. Remembering that both N and O give rise to atoms of mass 3 and that only N gives rise to H atoms
the basic structure of all three nuclii C, N and O is four atoms of mass 3 and charge 2.



Carbon.



Nitrogen.



Oxygen.

In addition the Carbon nucleus has 2 binding negative electrons, the Nitrogen has 2 H nuclii added and a binding electron. The Oxygen has a He nucleus instead of the 2 H nuclii.

If now after collision with a swift α particle the Nitrogen nucleus loses 1 Hydrogen atom the mass of the residual would be 13 and its nuclear charge 6. It would be an isotope of Carbon.

If the mass 3 is expelled the remainder should have mass 11 and nuclear charge 5 and would be an isotope of Boron.

The general conclusion to be drawn from all this extremely interesting discovery is that the Hydrogen nucleus is probably the + electron, of radius about $\frac{1}{2000}$ of the — electron and of relatively huge mass and that a Hydrogen *atom* is a system in which the — part revolves round the + part, the latter possessing nearly all the mass of the atom.

A most significant point is this: that the Hydrogen nucleus of charge $+e$ may, when associated in groups with negative electrons or alone, form the nuclii of all forms of matter. It is remarkable how the old Prout hypothesis is being revived in new form.

In order to suggest a mental picture of the dimensions involved I have worked out the relative sizes and distances of the components of the Hydrogen atom on an enormously magnified scale.

Imagine the negative electron to be a region in space of diameter 1 foot. Place a speck of dust, diameter $\frac{1}{100}$ inch at a distance of 6 miles from it. This will represent the positive electron. Let the large body rotate round the small one in $\frac{1}{10}$th second and you have a magnified picture of our present conception of the Hydrogen atom.

On this scale the α particle, diameter 12 inches would plunge through the atom with a velocity of 12,000 miles per second. If it by chance hits the speck of dust, the forces called into play are so tremendous that the speck deflects it through a large angle and is shot off itself to a distance (in this scale) of about 10^{15} miles, the confines of the known universe.

In a mass of hydrogen gas at N.T.P. the nearest atom would on the average be about 200,000 miles away and the pupil of Sir Earnest Rutherford's eye as he tried to observe what was going on would measure 10,000 the area of Neptune's orbit round the sun.

I now turn to some very vital aspects of the problem which concern the interpretation of spectra and spectral series. Let us confine our attention to hydrogen spectra alone as promising the greatest simplicity. The facts observed are briefly as follows. The gas can emit several spectra the chief of which are—

(1) the 6 line spectrum which may contain an infinite number of lines, which extend into the ultra violet and the frequencies of which are connected by the very simlpe law of Balmer. This is probably a molecule spectrum as far as the 6 lines seen in the laboratory are concerned. The rest is atomic;

(2) the secondary spectrum, containing also thousands of lines, which is undoubtedly an atom spectrum.

To what extent will the kind of H. atom we have already pictured, and which is built up on a strict basis of experiment, account for the above facts? It may be admitted at once that it does NOT account for the facts. Setting aside the bare possibility that spectra may have their origin in the vibrations of the nucleus, take the more probable conception that the external electrons are concerned. Firstly, it may be proved that a discrete negative electron revolving in an orbit must radiate energy into space. As it radiates, the total energy of the atom changes and therefore, also, the frequency of the oscillations; eventually the electron would fall into the central + charge. Thus a gas made up of atoms of this kind would show a continuous spectrum and not sharp lines, since in an observed mass of gas there would exist atoms giving every possible frequency.

In other words, sharp lines demand that the radius of the orbit should be constant or that it should have a definite number of possible stable values to which it could jump instantaneously. Now no possible application of Newtonian dynamics could account for discontinuity of this kind in such a system and the physicist finds himself in an impasse between the solid results of observation and the application of his ancient and cherished dynamical system. Some thing has to go and for the moment, the old dynamics is under criticism, or at least " under trial."

The bold speculation of Bohr which displaces the ancient system, is not quite new in kind. Speculations of the same nature were first put forward by Planck in 1901 in connection with thermal radiation. But I propose to consider the assumption of Bohr alone.

If ω is the frequency in the orbit he assumes that the angular momentum of the electron in its orbit $= \tau . \frac{h}{2\pi}$ where h is a universal constant (the same as was used by Planck) and τ is an integer, which may be 1 2, 3, etc. Thus the angular momentum, [which is $\frac{1}{\pi\omega} \times$ loss of energy of the electron] is equal to $1 \times \frac{h}{2\pi}$ or to $2 \times \frac{h}{2\pi}$ or to $3 \times \frac{h}{2\pi}$ and so on. In other words the angular momentum is conceived change by jumps.

This gives *definite fixed values, for the loss of energy*; for the *radius of the orbit*; and for the *frequency*, corresponding to each integer.

Since the radius cannot change unless τ changes, no oscillations in the plane of the orbit normally can occur, but the radius changes only by jumps. It follows from calculation that when a change of radius does occur energy is radiated and is absolutely monochromatic and is *always of fixed amount* $h\nu$ where ν is the frequency of the radiation emitted. Two lines of the same series are never given simultaneously from the same atom.

From this reasoning Bohr deduces very simply an exact statement of the empirical law of Balmer.

There are, however, other theoretical conceptions of the atom which also account for Balmer's law. The secondary spectrum remains at present unaccounted for.

I have only endeavoured to indicate the barest outline of a large subject in order to emphasize the fact that SOME THING MORE than the simple atomic structure which Rutherford has built up seems inevitable in order to explain the radiation of the atom. Of that " something " we can at present form no physical picture: but it seems clear from converging lines of reasoning that we are observing a special case of a far more general dynamical principle in the universe than has hitherto been suspected.

Another important attempt to explain the origin of spectral series, is due to Ritz in 1908. The assumption he makes is that the atom contains some mechanism which gives rise to an internal magnetic field.

This is pure assumption, so far as Ritz is concerned and he makes no attempt to account for the supposed field.

If, however, such a magnetic field exists in the neighbourhood of an electron describing an orbit in the atom, it is possible to obtain an expression for the frequency which is the same as that of Balmer.

Now recent researches of an experimental nature on the magnetic properties of iron and nickel have led to the supposition that a magnetic field of the order of 10^7 gauss for all atoms is a necessary part of the structure of magnetic material. These magnetic elements were called by Weiss' magnetons.

Still more recent work by Oxley on diamagnetism indicates that magnetic atom-fields of 10^7 or 10^9 gauss must exist. Humphrey's theory of the shift of spectral lines under high pressure postulates magnetic fields of the same order of magnitude.

Thus several converging and independent lines of research indicate that a magnetic unit of fixed value for all material inhabits the atom

So far there has been no direct evidence for its existence. I mentioned previously that Rutherford's work leads us to believe in the possible existence of electrical doublets of zero charge and mass 1, formed of one electron in close association with one negative electron. If such a system were spinning it is conceivable that the intense local fields demanded by Ritz and others might be accounted for.

The neutral doublet would in all probability be undetected by α-particle methods as at present practised.

I am not aware that this magnetic possibility has been worked out quantitatively, but if not, here is a problem for the mathematician.

Lord Kelvin is said to have remarked during his Jubilee address to the University, that he knew no more of the real meaning of electricity than he had done 50 years before.

The same remark could not truthfully be made nowadays, nevertheless it appears that the mystery has only been put back on to the deeper mystery of the electrical charge.

Our tongues roll glibly over the words positive and negative charge; we can express large charges in terms of a universal unit charge of which we know a good deal, but no one has ever defined what he means by charge, except perhaps to refer to it as a condition of volume density which, of course means nothing physically.

It seems likely that electrical charge, the basis of the atom will take its place alongside gravitation as a fundamental mystery and that any further penetration into its meaning will involve those fuller conceptions of time and space which have been applied with such remarkable results by Einstein and by modern astronomical research.

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NUMISMATIC SUPPLEMENT No. XXXVI.

ARTICLES 225-231.

Continued from "Journal and Proceedings", Vol. XVII, New Series, No 1.

225. THE MACHHLĪDĀR ṢŪBAH AWADH COINS.

In his article the Coins of the Kings of Awadh, published in N.S XVIII, Art. 112, p 255, Mr. Brown discusses the coinage during the Mutiny in the name of Brijīs Qadr. He records the tradition in the Lucknow bazar that it resembled the coins of Banāras which have a broad fish and the mint name صوبه اوده. The general correctness of the tradition has now been proved by the Oudh records in the office of the Board of Revenue. Attached to this note is a copy of a letter No. 189, dated 18th December, 1858, from the Deputy Commissioner, Lucknow, to the Commissioner and Superintendent, Lucknow. I have preserved the exact spelling of the original Most of the mistakes present no difficulty. The word "P Sendal" is probably a mistake for "provisional, and the Persian words *nishān māhī* probably refer to the representation of a fish."

The coins which had been received at Lucknow resembled closely the *machhlī shāhī* rupees of Shāh 'Ālam which were still being received at treasuries along with other uncurrent coins. As, however, the new coinage had been struck without authority, and was debased in varying degrees, a circular was issued directing district officers to refuse to accept it in the treasuries Any coins which had already been received were to be sent to the Accountant General for melting. The only district report received besides that from Lucknow was from Hardoi where 22,000 coins had been received. This rejection and order for melting account for the comparative rarity of these coins now.

R. BURN.

SIR,

I have the honour to request you will furnish me with early instructions relative to the treatment of a new species of Oude Currency.

2. During the Rebellion it seems a mint was established under the orders of Birjislkudr, the P Sendal king and a new coin struck and extensively circulated in this Province.

3. It has some resemblance to the Mutchlee Shahee rupee, now current, and bears the device noted in the margin. It is of an inferior description and the intrinsic value much below the standard currency. The coins even vary in value, the

maximum is 15 annas, while some are not worth more than 14 annas.

Obṣerve (sic).	*Reverse.*
حامي دین شاه عالمے	سنه ۱۲۲۳ جلو
بر هفت کشور شد	صوبه نشان ماهي

4. The Tehseeldars of Lucknow and Goorsaingunge have sent in 79 such rupees in their remittance, but I have not yet issued any orders to them on the subject, pending a reply to this reference.

5. I need hardly observe that all light weight rupees are received in the Treasury as bullion but the new coin, altogether inferior in value, is full weight and cannot be treated as such.

6. If the coin is to be received by tale it will be necessary to fix a suitable rate of discount to be determined with reference to the value of the specie. In our older Provinces Malgoozars are allowed the privilege of tendering other than Co.'s rupees and the batta varies from 1 to 6 per cent according to the description of coins tendered.

7. But the rupee in question is inferior to all kinds receivable in the Treasury and liable to the exaction of a heavy Batta, which I apprehend will materially retard its withdrawal from circulation and this is a matter of considerable importance.

8. I have prohibited the re-issue of the coin and await your orders on the subject

I have, etc ,
Sd S. Martin.
Deputy Commissioner.

Lucknow, Dy. Comm.'s Office,
The 18th December, 1858.

226. ŪJHĀNI AS A MINT TOWN.

The rupee described below was brought to me recently and is interesting as adding yet one more to the list of Mughal mints.

Ūjhānī is a town of between seven and eight thousand inhabitants, the capital of a pargana and about eight miles south-west of Budaon.

After the death of ʻ Alī Muḥammad Khān the Rohilla chief in A.D. 1748 (=A.H. 1161), and the release four years later of his sons Abdullah and Faiẓullah who had been sent to Qandahār by the Emperor Muḥammad Shāh, a partition of Rohilkhand was effected and the Ūjhānī pargana fell to the share of Abdullah. Here he ruled in peace till his death in 1761 A.D. (=1174 A.H.)

It was in the latter year that this rupee must have been struck either by Abdullah or his son Naṣrullah. It is to be noted that it follows the Barelī (Rohilla) type. It came to me with other coins of Rohilkhand mints of the same period.

Obv.

الله
بادشاه
حامي دىن شاه عالم
فضل
زد به هفت کشور آىنه
سکه

Rev.

مانوس
مدمنت
جلوس ۲ سنه
ضرب
سکه او جهادى

On the obverse the word آىنه (mirror) replaces the usual ساىه. The two dots under the "ye" and the dot over the "nūn" make the reading clear.

On the reverse the use of the سکه before the mint name is a peculiarity.

H. Nelson Wright.

227. The Coins of Muhammad Akbar as Claimant to the Mughal Throne.

I have on purely numismatic grounds suspected for some time past that coins were issued during the troubled period 1202–03 A.H in the name of a Mughal claimant Muhammad Akbar hitherto unrecognized as such Towards the end of November, 1919, I put the question to Professor S. H. Hodīvālā as follows: 'Is it possible that a claimant called Muhammad Akbar, an individual either distinct from or the same as the personage who afterwards became Muhammad Akbar II, was pushed forward in addition to Bedār Bakht as a claimant to the Mughal throne in the troubled period 1202–03 A.H.? Is there anything in history to warrant such a theory'? His reply was sufficient to show that there were historical grounds for holding that the second son of Shāh 'Ālam, Prince Muhammad Akbar, who regularly ascended the throne twenty years later, was set up as emperor by Ghulām Qādir after that swashbuckler had been obliged to discard Bedār Bakht on account of the latter's unsuitability. The name of Muhammad Akbar must therefore be added to the list of Mughal claimants who issued coin. I now proceed to describe the numismatic evidence and leave Professor Hodīvālā to give the historical material in the companion paper.

Coins of Muhammad Akbar as claimant.

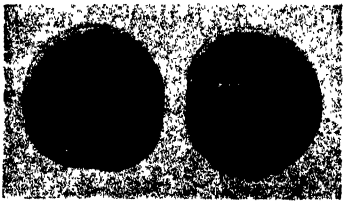
1. Rupee of date 1203 A.H., first regnal year, mint Dāru-s-Surūr Sahāranpūr.

Obverse.	*Reverse.*
اله محمد اکبر	دار السرور سهارنپور
شاه	ضرب
فضل حامي دين ۱۲۰۳	جلوس میمنت مانوس
سکه	احد

The couplet is something like this :—

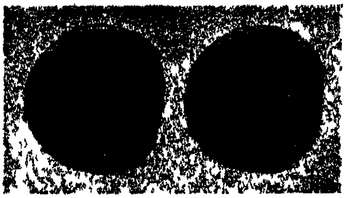
سکه زد در جهان سایه فضل اله
حامي دين محمد اکبر شاه

'Struck coin in the world, the shadow of the divine favour. The defender of the faith of Muḥammad, Akbar Shāh.'



2. Æ.

Obverse.	*Reverse.*
اکبر شاهی	احمد آباد
فلوس ۱۲۳	ضرب
	Fish احد Sword



3.	*Obverse*	*Reverse*
	اکبر شاهے	شاه جهان آباد
	فلوس ۲۳ ...	ضـــــــرب
		Fish
		احد
		سـنه

All three in my Cabinet.[1] A duplicate of (1) in the Panjab Museum.

R. B. WHITEHEAD.

10th August, 1920

It has not yet been possible to find an absolutely complete and satisfactory solution of the problem connected with the Muḥammad Akbar coins of 1203 A H., but there would seem to be fairly good grounds for answering Mr. Whitehead's question in the affirmative. The period was a troubled one and its history is obscure The fullest account of the transactions which led to the deposition and blinding of Shāh 'Ālam II is in the *'Ibratnāma* of Faqīr Khairu-d-dīn Muḥammad, but this work has not yet been published. Portions are translated in the eighth volume of Elliot and Dowson's History of India (pp. 238–245), but the extracts unfortunately stop short at the most critical point. Indeed, Dowson informs us in the prefatory bibliographical notice that "it closes soon after recounting the horrible cruelties practised on the Emperor Shāh 'Ālam and his family, by the infamous Ghulām Kādir whose atrocities he describes at length and * * * whose career induced the author to give his work the title of *'Ibratnāma*, Book of Warning," (op. cit. VIII. 237). There is a fairly detailed narrative of the events of this memorable year in Keene's 'Fall of the Mughal Empire' which is avowedly an abstract paraphrase of the *Tārīkh-i-Muẓaffarī* of Muḥammad 'Alī Khān Anṣārī (Keene, op. cit., 282), but it throws no real light on the matter in issue. I have a manuscript of the Persian original and waded through the folio in the hope of lighting upon some details which Keene had missed or left out, but the labour proved unfruitful. A search through the *'Imādu-s-S'ādat*—another of Keene's authorities (Kāhnpūr Lithograph, 1897 A.C.)—turned out to be equally infructuous. However, some time afterwards, I was delighted to find a clue to the solution of the puzzle in Seton-Karr's 'Selections from the Calcutta Gazettes.'

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[1] Mr. Whitehead's coins have since been purchased by the British Museum. In the illustrations to coins Nos. 2 and 3 the obverse and reverse have been transposed.

In the first volume of this compilation, there is a long account of the 'Revolution at Dehlee' extracted from the 'Calcutta Gazette' of Thursday, August 21st, 1788, which begins thus: "On the 2nd instant, Ghoolam Cadir Khan and Ismail Beg Khan deposed the king Shah Alum and placed on the throne of Hindostan, Beidar Bukht. son of Ahmud Shah and grandson of Mohummud Shah. The circumstances of the revolution extracted from the authentic Dehlee papers are as follows." (Op. cit. I. 262.) This lengthy account does not contain anything new and may be passed over. In the immediately consecutive number (August 28th), the blinding of the emperor is recorded. "Maleeka Zemanea widow of Mohummud Shah and Sahibah Jahul (*recte,* Mahal, see ED. VIII, 250), an old lady resident in the metropolis, supplied Ghoolam Cadir Khan and Ismail Beg with several lacks of rupees After dethroning the King, they plundered him and put out his eyes and confined him." (Ibid. 265.) The cruel blinding of the poor emperor is reported on September 4th with the remark that the mode in which it was carried out with "a Peshcubz or short sharp-pointed dagger" must have made "the horrid act of barbarity peculiarly agonizing to the last degree." (Ib. 266.) After this there is no reference to Dehlī or its misfortunes for just three months. But the following item of news was published in the issue of December 4th, 1788. "Nothing particular has of late transpired at Delhi; the last accounts from that quarter announce the continuance of Golaum Kadir Cawn, accompanied by his new elected king Mirza Akbar Shaw. his late king Bedar Shaw and several other Princes, at a place called Meerut about four days march from his capital Saharanpur. His Army experiences every distress from the scarcity kept up by the Mahratta Army under Ranna Khan, Himut Behadre &c, who cut off all his supplies and have hitherto prevented him from proceeding into Ghousghur. Scindea still remains at Mattura, and the old king Shah Alum is treated with every respect by the Mahratta influence." (Ibid. p. 273.)

Now this is just the sort of evidence we want, the historical warranty we are in search of. Here is a contemporary journalist asserting, on the authority of the last accounts from that quarter, i e. the Dehlī *Akhbārs* or Persian and Urdu news-letters, that the unspeakable Rohilla had gone to Meerut "accompanied by his new elected king Mirza Akbar Shaw, his late king Bedar Shaw and several other princes." Nothing could be more explicit or more germane to the matter than this simultaneous mention of both puppets with their individual names and the qualifying epithets 'new elected, and 'late.' It is true that the necessary corroborative evidence from the indigenous chronicles is not yet forthcoming, but there is every reason to hope, if not to believe, that it will be discovered when these sources of information are published and examined by competent scholars.

It is common knowledge that the king-maker very soon became dissatisfied with Bedar Bakht on account of his stupidity and childishness. It is said that the favourite amusement of the new titular, who had passed all his life as a prisoner in the *Deorhī-i-Salāṭīn* (*q.v.* Elliot and Dowson, VIII, 141, 247 *n*), was the flying of kites in the streets of the metropolis Keene writes that "on the 3rd of August, Gholam Kadir gave proof of the degraded barbarity of which Hindustani Pathans can be guilty by lounging on the throne on the Diwan Khas, side by side with the nominal emperor *whom he covered with abuse and ridicule as he smoked the hookah in his face.* On the 7th he visited the Emperor in his confinement and *offered to put on the throne Mirza Akbar, the Emperor's favourite son* who did in fact ultimately succeed. The only answer to these overtures was a request by Shah Alam that he might be left alone" (Op. cit. 179–80.) (The italics are mine.)

This last statement is interesting and demands notice. It shows that the idea of raising Muḥammad Akbar to the throne had occurred to Ghulām Qādir three days, at least, before the perpetration of those barbarities which have made him infamous for all time.[1]

It is true that Keene, or rather his authority, does not assert that Muḥammad Akbar was at this time, or at any other, actually elevated to the *Masnad*, but the statement may, even as it stands, be fairly said to support the allegation of the contemporary newswriter. And this taken in conjunction with the numismatic testimony, which is now fairly clear, may entitle us to hold that *at some time during the Revolution*, Muḥammad Akbar, the second son of Shāh 'Alam, *was* set up as Emperor by the Rohilla.

When this exactly took place, it is in the present state of knowledge impossible to say, but it may be worth while inviting attention to certain considerations which enable us to fix the time within very narrow limits. The Hijri date on the rupee in the Panjab Museum (P.M.C. 3277) as well as the copper coins in Mr. Whitehead's own cabinet is 1203. Now if they were struck, as is not unlikely, merely to commemorate the accession of the new *fainéant*, that event could not have occurred *before* 2nd October, 1788, which answers to 1 Muḥarram, 1203 A.H.

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[1] If the 'Calcutta Gazette' or the sources of its information, the "Dehlee papers" are to be credited, Isma'Il Beg from the first "did not approve the choice formed by Ghoolam Cadir to fill the throne so ungratefully made vacant by him." (Loc. cit., 264.)

Again, one of the copper coins bears the mint-name Shāhjahānābād. If any importance can be attached to this superscription, that is, if the coin is taken to have been really struck at Dehlī, the nominal inauguration of the second puppet could not have taken place *after* 11th October, 1788 A.C., for we know that on that day Ghulām Qādir "finally departed, leaving the Salimgarh by a sally-port and *sending before him the titular Emperor,* * * * *and all the chief members of the royal family.* (Keene, op. cit., 185).[1]

It is true that the companion *fulūs* exhibits the name Aḥmadābād, but it is not improbable that this coin was, like the Aḥmadābād issues of Bedār Bakht, minted, as Mr. Master has conjectured, "not very far from Shāhjahānābād." (Num. Sup. XXII, p. 165.) The rupee in the Lāhor Museum was ascribed by Rodgers to Akbarābād, but the reading "cannot be justified" and the name must for the present be pronounced illegible.

In a word, *if it is granted* that these coins were first struck at Shāhjahānābād in 1203 A.H., it follows that the nominal accession of Muḥammad Akbar which they were perhaps intended to mark, must have taken place at some time between 2nd and 11th October, 1788 A.C. The Marāṭhas were increasing in strength and numbers; Isma'īl Beg was negotiating with them; the 'last attempt of the Rohilla 'to shake the obstinacy of Shāh 'Ālam about the hid treasure" had failed. He was "hemmed in by difficulties" on all sides and he may have hoped to arrest "the shadow of an advancing vengeance" Keene, loc. cit., 183-4), or make his peace with the populace of the capital by raising to the throne 'the favourite son' of the deeply-injured Emperor.

S. H. Hodīvālā.

15*th June*, 1920.

228. The Coinage of the Sharqī Kings of Jaunpūr.

1. *History and Chronology.*

Only meagre information regarding the history of the rule of the independent Muhammadan Kings of Jaunpūr is obtainable from the works of contemporary historians, few of whom have attempted to compile a history of the dynasty

Information on the subject has to be searched for from among the many histories of the central kingdom of Dehlī and the items referring to the Jaunpūr dynasty when extracted and compared are not always consistent; sometimes the discrepancies are practically irreconcilable The many histories, translated either in full or in part, in "The History of India as told by its own Historians" of Sir H. M. Elliot. are a source of help in the search for information of the history of the Sharqī dynasty, but unfortunately the best contemporary history of the period, that of Yahyā bin Aḥmad—the *Tārīkh-i-Mubārak Shāhī*—closes abruptly at a very interesting period.

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[1] It is perhaps worth noting that the Calcutta newswriter also speaks of Ghulām Qādir having been accompanied in his flight to Meerut not only by "Bedar Shaw" but by "several other princes."

Among the works of other more or less contemporary historians which afford help towards the elucidation of the history of the Sharqī dynasty are, the *Ṭabaqāt-i-Akbarī* of Niẓāmu-d-dīn Aḥmad, the *Tārīkh-i-Fīroz Shāhī* of Shams Sirāj Afīf, the *Muntakhabu-t-Tawārīkh* of 'Abdu-l-Qādir ibn-i-Mulūk Shāh, known as al-Badāonī, the *Tārīkh i-Firishta* of Muḥammad Qāsim Shāh Firishta, the *Tārīkh-i-Dāūdī* the *Tārīkh-i-Khān Jahān Lodī* and the *Tārīkh-i-Salāṭīn-i-Afghānia* of Aḥmad Yādgār.

The above are all to be found in "Elliot and Dowson" and in addition we have Dorn's translation of the *Makhzan Afghānī*; Maulavī 'Abdu-s-Salām's translation of the *Riyāẓu s-Salāṭīn*, Colonel Ranking's and Professor Lowe's translation of the *Muntakhabu-t-Tawārīkh*, Brigg's "Ferishta" and the portion of the *Ṭabaqāt-i-Akbarī* translated by Mr. Dé · all of which help to contribute to our knowledge of the history of the period of Muhammadan rule at Jaunpūr. The information is however scattered and I have no doubt but that a close search in other contemporary works would further increase our knowledge of the history of this Muhammadan dynasty.

Some historical chapters are included in the Archaeological Survey of India's publication on the Sharqī Architecture of Jaunpūr, 1889, and for material on the subject Führer was able to refer to a ' Jaunpūrnāmah "[1] of Faqīr Khairu-d-dīn Muḥammad Ilahābādī—a history of the town of Jaunpūr from the middle of the 14th century written about the year 1796 A.D. Führer also makes references to an "Ahwalat Jaunpur wa Sultan Hindustan" (*sic*) Colonel H. R. Nevill was able to consult a manuscript ' Manāqib Darweshia" of one Sayyad Darwesh when compiling his volume on Jaunpūr in the series of District Gazetteers of the United Provinces of Agra and Oudh, published in 1908

In the reign of Sulṭān Ghiyāṣu-d-dīn Tughlaq Manaichh was the chief town in the district which later was to include the capital of the Sharqī Kings and the district was held by Gaharwar Rajputs In A.H. 721 (A.D. 1321) a force under Ẓafar, the third son of Ghiyāṣu-d-dīn seized Manaichh and

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[1] Cf Rieu's Catalogue of the Persian manuscripts in the British Museum, Vol. I, p. 311.

Ghiyāṣu-d-dīn conferred the district as a *jāgir* on Ẓafar.[1] The name of the town was altered to Ẓafarābād There is an inscription at Ẓafarābād dated A.H. 721 bearing the name of Sulṭān Ghiyāṣu-d-dīn which appears to have been recorded by this Ẓafar and which commemorates the change of name of the town [2]

Niẓāmu-d dīn Aḥmad[3] states that the fief of Ẓafarābād was granted in A.H. 721 to "one whom he had called his son" and who was also granted the title of Tātār Khān. These two (viz. Ẓafar and the holder of the title of Tātār Khān) are possibly one and the same person and, we know that Tātār Khān was in possession of the *jāgir* in A.H. 724 (A.D. 1324) when Sulṭān Ghiyāṣu-d-dīn made his expedition to Bengal.

'Ainu-l-mulk held the *jāgirs* of Awadh and Ẓafarābād in the reign of Muḥammad bin Tughlaq and went into rebellion in A.H ' 747 (A.D. 1346); he was defeated and captured but eventually reinstated.[4]

Fīroz Shāh Tughlaq made two expeditions to Bengal and on his second expedition either during his outward journey or on his return he halted at Ẓafarābād (either in A H. 760 or A.H. 761) during the rains and arranged for the building of a new city on the banks of the Gūmtī which he decided to call "Junānpūr" in memory of Sulṭān Muḥammad bin Tughlaq [5] The *Ṭabaqāt-i-Akbarī* tells us that shortly after leaving Ẓafarābād *en route* to Bengal Fīroz had conferred the paraphernalia of state (canopy, durbāsh, elephants, red pavilion, and right of coinage) on his son Fatḥ Khān,[6] who was then eight years of age and who died on the 12th of the month of Ṣafar A.H. 776 (A.D. 1374) at Kanthūr, a village in the Bara Banki district of Awadh.[7]

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[1] Cf. District Gazetteer, p. 150.

[2] Cf. "Jaunpur and Zafarabad Inscriptions"—Vost, J.R.A.S., 1905.

[3] Dé's translation of Ṭabaqāt-i-Akbarī, p. 209.

[4] Cf. Brigg's Ferishta, p. 430, and al-Badāonī (Ranking's translation), p. 312.

[5] Tārīkh i-Fīroz Shāhī of Shams Sirāj Afīf.

[6] Dé's translation, p 246

[7] Just as I was about to send this paper to the editor and while on leave in England J.A.S.B., Vol. XVII, N S. XXXV has reached me. I see that Colonel Nevill, in his very interesting articles "Fīroz Shāh Ẓafar, ibn Fīroz Shāh" and "Coins of the Pathan Kings of Dehlī: Fīroz Shāh and the later Tughlaqs," has dealt with the sequence of events in the eastern portion of the Dehlī kingdom and mentions that Ẓafar "appears to have succeeded for a time to the viceregal appointment of Jaunpūr." I notice that Colonel Nevill does not accept Thomas' statement that Fatḥ Khān died in A.H 776. It is unfortunate that I have not quoted the authority from which I obtained the information above *re* date and place of Fatḥ Khān's death, but I believe it was from the Tārīkh-i-Mubārak Shāhī of Yahyā bin Aḥmad. I am glad to be able to record that the unique coin of Fatḥ Khān bearing the title "حبيب الشرق و الغرب" is now in the British Museum.

According to the *Tārīkh-i-Mubārak Shāhi*[1] the fief of Jaunpūr and Ẓafarābād was given in A.H. 778 (A.D. 1376) to Malik Bahrūz Sulṭānī, otherwise known as Ṣāḥibzāda Nāṣir Khān, who was another natural son of Sulṭān Fīroz Shāh. There is little on record regarding this man and no explanation as to why he should have borne the title "Sulṭānī." There is a masjid in the fort at Jaunpūr which is ascribed to one Ibrāhīm Nāīb Bārbak, a brother of Fīroz Shāh, and an inscription on the *minār* states that the mosque was built in A.H. 778 by "Ūlugh A'ẓam Nāīb Sulṭān."[2] Nevill[3] states that Malik Bahrūz was succeeded by his nephew 'Alāu-d-dīn.

Malik Sarā, the reputed founder of the independent kingdom of Jaunpūr appears to have set out from Dehli to take up the appointment of Maliku-sh-sharq in the month of Rajab A.H. 796 (A.D. 1393). A eunuch, he was governor of Dehlī and vazīr (with the title of Khwājah-i-Jahān) to Sulṭān Nāṣiru-d-dīn Muḥammad, the grandson of Sulṭān Fīroz Shāh who succeeded to the Dehlī throne on December 20th, A.D. 1389. He lost his appointment temporarily in August 1390, but regained it in the following year. He retained his appointment during the forty-five days reign of the son Humāyūn who succeeded his father on the throne of Dehlī under the title of Sikandar Shāh.[4]

On the accession of Nāṣiru-d-dīn Maḥmūd Tughlaq Malik Sarā was sent to govern the eastern provinces—according to al-Badāonī,[5] with the title of "Sulṭānu-sh-sharq" but according to Firishta,[6] with the title only of "Maliku-sh-sharq." Firishta states that he assumed the title of "Sulṭānu-sh-sharq" "after consolidating his position." The *Tārīkh-i-Mubārak Shāhī*[7] states also that his title at the outset was "Maliku-sh-sharq."

There can be no question but that he became more or less independent of the central power at Dehlī but to what extent it is difficult to say. A sign that a Muhammadan governor had thrown off all allegiance to the throne was an issue of coinage in his own name. We have no evidence that this "Sulṭānu-sh-sharq" ever issued independent coinage. On the other hand we have instances in Indian history where a governor was actually appointed to a kingdom by the supreme ruler and yet refrained from coining. An example exists in the case of Quṭbu-d-dīn Aibak who, on the death of Muḥammad bin Sām, was sent the canopy and insignia of royalty by Sulṭān Ghiyāṣu-d-dīn Muḥammad, yet refrained from coining independently. A Bihār inscription of the governor Ziau-l-Ḥaq bin ʻ Alī, as pointed out by Mr. Blochmann in the Journal of the Asiatic Society of Bengal of 1873, lends confirmation to the theory that Malik Sarā did not assume all the ensigns of royalty. The inscription bears the name of a Maḥmūd Shāh who must be Maḥmūd Shāh Tughlaq of Dehlī Firishta[1] and Yaḥyā bin Aḥmad[2] both give the date of his death as A H 802 (A.D. 1399).

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[1] "Elliot and Dowson," Vol. IV, p. 13.
[2] Cf. "Sharqi Architecture," pp. 26, 27.
[3] Gazetteer, p. 246.
[4] Ṭabaqāt-i-Akbarī, Elliot and Dowson, Vol. IV, p. 27.
[5] Bibliotheca Indica translation, p. 348.
[6] Briggs Vol. I, p. 479 and Vol. IV, 360.
[7] Elliot and Dowson, Vol. IV, p 29.

Among his retinue on the occasion of his departure from Dehlī to take over the government of the eastern provinces were two brothers each of whom was destined to succeed to independence. There is doubt as to their origin and as to the degree of relationship between them The one who immediately succeeded Malik Sarā is called variously "Malik Wasil" and "Qaranful" and Firishta states that he was granted the title of "Maliku-sh-sharq" when Malik Sarā assumed the more magnificent one of "Sulṭānu-sh-sharq."

On the death of Malik Sarā "Qaranful" set himself up independently as Sulṭānu-sh-sharq and assumed the title of Mubārak Shāh; according to Firishta at the same time assuming all the ensigns of royalty and even going to the extent of coining in his own name No coins of his are however forthcoming and it is extremely doubtful if any such issue was made. At any rate, whatever degree of independence he set up, it was sufficient to cause Iqbāl Khān, who was then master of Dehlī, to move an army against him in A H. 803 (A.D. 1400). The movement achieved little, Mubārak Shāh died suddenly, and his brother set himself up in his stead under the title of Shamsu-d-dīn Muẓaffar Ibrāhīm Shāh. Firishta gives the date of Mubārak's death as A.H. 803 and the length of his reign as eighteen months, but the historical records of these years are very meagre.

The records of the Sharqī Kings are usually a mere recital of military operations, events indifferently described and not free from doubtful and confused statements.

During his reign Ibrāhīm Shāh was constantly engaged in war with his neighbours, Dehlī, Bengāl and Mālwā but he found time also to embellish his capital with magnificent architecture. Ibrāhīm reigned probably from about the year A.H. 804 (A.D. 1401) to about the year A.H. 844 (A.D. 1440), but there is doubt both as regards the exact date of his accession and the date of his death. It has hitherto been generally accepted that he succeeded to the Sharqī kingdom in A.H. 803 and the determination of this date has to a certain extent rested on the fact that a coin of Ibrāhīm Shāh is catalogued in the British Museum Catalogue as dated A.H. 803. I have lately had the opportunity of examining the coin in question and have no hesitation in reading the date it bears as A.H. 833.

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[1] Briggs, Vol. IV, p. 360.
[2] Elliot and Dowson, Vol. IV, p. 37.

Another coin of Ibrāhīm Shāh was catalogued in the Ellis Sale Catalogue as dated A.H. 803, but I have not seen the coin and in the absence of more reliable proof to the contrary it would be wisest to reject the date and accept al-Badāonī's statement that Mubārak Shāh died in A.H. 804. The earliest reliable date for a coin of Ibrāhīm Shāh is A.H. 813—one of this date having been recorded by Thomas and one of similar date being in the collection of Colonel H. R. Nevill.

There is also doubt as to the accuracy of Firishta's statement that Ibrāhīm died in A.H. 844 (A.D. 1440) "after a long reign of upwards of forty years." Coins of Ibrāhīm Shāh are in existence dated A.H. 845, 846, 847, but coins of his successor are also in existence dated in sequence from the year A.H. 844. I am in possession of a billon coin of Maḥmūd dated very clearly A.H. [8]36 and Colonel Nevill has a coin of similar type dated A.H. 837. The double issue during these years is unaccounted for in historical records. Ibrāhīm must have been of considerable age at the time of his death and it is possible that his eldest son Maḥmūd set up independence before his demise

The *Laqab* or honorary title assumed by Maḥmūd Shāh was "Saifu-d-dunyā wa-d-dīn," but, if his coins have been correctly read, he would appear to have indulged in two surnames or *kunyats*, a not uncommon habit of Muhammadan kings of that time and one regarding which Dr. Hoernle wrote an interesting article in the Journal of the Asiatic Society of Bengal in 1883.[1]

On his gold issue Maḥmūd used the surname Abūl Mujāhid, whereas on a small billon issue he called himself Abūl Muẓaffar. It may here be noted that Blochmann in his "Geography and History of Bengal" in the Journal of the Asiatic Society of Bengal" 1873 (pp. 304–7) gives the *laqab* of Maḥmūd in an inscription on a mosque in Bihār as Nāṣiru-d-dīn. This is not in accordance with numismatic evidence.

The historical records of Maḥmūd's reign are again a mere description of a series of military events—of wars carried out against the neighbouring kingdom of Mālwā and of attempts to secure the throne of Dehlī. Maḥmūd had married a daughter of Sulṭān Alāu-d-dīn 'Ālam Shāh of Dehlī and as he also claimed descent from the Sayyads there was reason why he should aspire to oust the Lodīs from their suddenly acquired throne. On at least one occasion he was within measurable distance of attaining his object but fortune favoured Bahlol Lodī who managed to save his kingdom.

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[1] "A New Find of Muhammadan Coins of Bengal (Independent Period)," J.A.S.B., 1883, pp. 212-218.

As remarked by Mr. Lane-Poole in his introduction of the British Museum *Catalogue of Coins of Muhammadan States* and as discussed by Mr. Nelson Wright[1] in Part II of Volume II of the *Catalogue of Coins in the Indian Museum, Calcutta*, there is some doubt as to the exact date of Maḥmūd's death. Thomas states at page 323 of his "Chronicles of the Pathan Kings of Dehlī" that General Cunningham had informed him that coins of Maḥmūd were known of A.H. 862 and 863, but Mr. Nelson Wright rejected this as he was unable to find such dated coins in any collection, having apparently overlooked the billon issue catalogued under No. 617 in the Bodleian Library Collection Catalogue as dated A.H. 862, and also the copper coin dated 862 A.H. catalogued under No. 618. Colonel H. R. Nevill is now in possession of another billon coin of Maḥmūd dated A.H. 862. Coins both of Muḥammad and of Husain exist dated A.H. 861, 862 and 863. Did Maḥmūd die in A.H. 861 and was his kingdom then divided between his two sons? Both sons aspired to supreme power and undoubtedly both issued coins in the same three years. The statement of Firishta that Muḥammad reigned only five months is not in accordance with numismatic evidence, but further information is required before the date of the death of Maḥmūd can be definitely fixed. A coin of his in the Indian Museum (No. 100 of the Catalogue) dated A.H. 865, should probably be considered a posthumous issue; but should those dated A.H. 862 be also so classed?

The accession to the Sharqī throne of Bīkhan Khān, son of Maḥmūd, under the title of Muḥammad Shāh caused strife within the kingdom, as Ḥusain, another son of Maḥmūd, also aspired to paramount power. From contemporary histories it would appear that Muḥammad Shāh was the eldest son, but Führer states that allusions by Faqīr Khairu-d-dīn seem to indicate that this is not certain The usual murders occurred, Muḥammad Shāh was eventually killed, and Ḥusain gained the throne.

Ḥusain, like his father, and to his eventual destruction, laid claim to the Dehlī throne and the information regarding happenings during his reign which has descended to us is again a mere recital of military operations. Bahlol Lodī eventually drove him from his kingdom and (about the year A.H. 881 [A.D 1476], according to Firishta) Husain sank to the status of a jāgirdār of Chunār.

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[1] In his discussion regarding the date of Maḥmūd's death Mr. Nelson Wright referred to an inscription which had been found at Dhākā bearing Maḥmūd's name with the date A.H. 863. This inscription was originally published by Blochmann in J.A.S B., Vol. XIII, pp. 107–8 and was again mentioned by that gentleman in his "Geography and History of Bengal," J.A S.B., 1873, p. 270; in the latter article the inscription was referred to its rightful sovereign, viz Nāṣiru-d-dīn Abūl Muẓaffar Maḥmūd Shāh of Bengal.

The earliest coin known of Bahlol Lodī which bears the mint name Jaunpūr is dated A.H 888 and probably Ḥusain was in full power up to the year A.H. 883. Führer states that Khairu-d-dīn Muḥammad in his *Jaunpūrnāma* gives the date of the final deprivation of his kingdom of Ḥusain as A.H. 884 (A.D. 1479). Numismatics do not at present help to elucidate the point as coins of Ḥusain run in complete sequence to A.H. 911 and then irregularly to A.H. 919. Although the later dated coins are posthumous we have no information as to who issued them and from what date Ḥusain's personal monetary issues ceased. Bahlol Lodī administered the Sharqī kingdom himself for several years and his coins bearing the mint town name Jaunpūr are known in complete sequence from A.H. 888 to A.H 893.

In either A.H. 892 or A.H. 893 (according to numismatic evidence the first date would appear to be the correct one), Bahlol placed his son Bārbak on the Sharqī throne and, before his death, when dividing his kingdom among his sons, he confirmed the appointment. Sikandar Shāh who received the Dehlī kingdom was almost certainly not the true heir to that inheritance and Bārbak engaged in an attempt to oust him. Bārbak was defeated, surrendered to Sikandar, and was reinstated on the Sharqī throne, but was eventually removed by Sikandar who entrusted the government of Jaunpūr to that Jamāl Khān who was destined to be the first patron of the great Sher Shāh Sūrī.

Coins of Bārbak Shāh are known of A.H. 892, 894, 895 and 898 and these dates agree with the records of Indian historians.

Sharqī events subsequent to the removal of Bārbak Shāh are uninteresting from the numismatic point of view but there is a field for enquiry as to who issued the posthumous coins of Ḥusain. Firishta states that Ḥusain's family became extinct in his person but Führer, quoting the *Jaunpūrnāma* as his authority, records that he left a son Jalālu-d-dīn who married into the family of the Ḥusainī dynasty of Bengal. There are graves in Jaunpūr (where Ḥusain, who died in A.H. 905, is himself buried) which are said to be those of the descendants of Ḥusain and it is possible that one or other of these descendants was responsible for the issue of posthumous coinage in the name of Ḥusain Shāh.

2. *Coin Types.*

Of all the coins issued by Muhammadan dynasties in India perhaps those of Ibrāhīm, Maḥmūd, Muḥammad and Ḥusain most easily adapt themselves to description by "type."

The patterns introduced by Ibrāhīm Shāh were reproduced by his three immediate successors who, although they occasionally introduced a new type, usually contented themselves with substituting (or adding) their names to the legends of the issues of their predecessor.

Ibrāhīm, Maḥmūd and Ḥusain coined in gold but no issue in this metal is known of Muḥammad Shāh. Ibrāhīm certainly indulged in an issue in silver and a silver coin of Maḥmūd Shāh, struck probably from the gold die, is in Mr. Nelson Wright's collection. No silver issue is known of Muḥammad or of Ḥusain.

All four kings coined in billon and in copper.

Gold.

Ibrāhīm issued two types of coin in this metal, the earlier of which bore a close likeness to the gold issue of Fatḥ Khān Tughlaq. Maḥmūd and Ḥusain apparently minted the second type only.

Type I complies with the normal weight of 175 grs. for a Dehlī tanka—a specimen in the British Museum collection however exceeds this weight.

The legend on the obverse consists of a central inscription enclosed in a circle with a marginal legend giving the date in Arabic words following the formula "minted as a *dīnār* in the year........"[1]

The central inscription reads:—

"In the time of the Imām, Commander of the Faithful, Father of Victory, may his *khilāfat* be perpetuated"

The reverse legend which occupies the full face of the coin, reads:—

"The supreme sovereign, the sun of the world and religion, Abūl-Muẓaffar Ibrāhīm Shāh, the Sulṭān, may his kingdom be perpetuated."

The issue of this type of gold coin was apparently made only by Ibrāhīm[2] and he appears to have stopped the issue sometime between the years A.H. 836 and A.H. 840.

I am able to record dated coins of Type I of the years

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[1] Mr. Lane-Poole in the Catalogue of Indian Coins in the British Museum, Muhammadan States, draws attention to the grammatically incorrect use of the feminine verb and pronoun ضربت with the masculine noun هذا.

[2] Coin No. 4374 of the White King Collection Sale Catalogue was a gold coin of Maḥmūd of A.H. 845. Reference is made in the catalogue to Type I of the gold issue of Ibrāhīm, but as reference is also made to Type II of the same king the catalogue affords no evidence that Maḥmud ever issued coins of Type I. Thomas however at page 321 of his ": Chronicles" mentions (*b*) a coin of Maḥmūd of date A H. 855 and weight 175 2 grs. as having been in the Guthrie collection. I can find this coin in no collection and am therefore unwilling to include it in this list.

A H. 830, 831 and 836 while the record of issue of Type II is complete from A H 840 to A.H. 843, both years inclusive.

Type II.—This is the "organ-pipe" type; a name derived from the *Tughra* form of the reverse legend, an innovation apparently copied from the issue of Jalālu-d-din Muḥammad Shāh of Bengāl, the earliest of whose coins in the *Tughra* form is, as far as I know, A.H. 821. (cf. I.M.C. No. 107.) The obverse legend follows that of Type I except that the title "Commander of the Faithful" is altered to "Deputy-Commander of the Faithful." The marginal inscription however remains the same. On the reverse Ibrāhīm expresses his religious belief by prefixing the legend—

"The one who trusts in the support of the Merciful"

to his title

"Abūl Muẓaffar Ibrāhīm Shāh, the Sulṭān."

The coins of Maḥmūd and Ḥusain in this type bear the same obverse legend as those of Ibrāhīm but the reverse legend, in the case of the issue of Maḥmūd reads :—

"Minted by the Sulṭān Saifu-d-dunyā wa-d-dīn Abūl-Mujāhid Maḥmūd son of Ibrāhīm."

The legend on the reverse of the coin of Ḥusain reads :—

"Strengthened in the support of God Ḥusain Shāh (son of) Maḥmūd Shāh (son of) Ibrāhīm Shāh, the Sulṭān, may his kingdom be perpetuated."

The use of two *kunyats* by Maḥmūd Shāh has already been mentioned.

Weights.—There are too few gold coins of the Sharqī kings available on which to conjecture even approximately the weight of issue. I can do no better than give below the present weights of the various coins which have come to my notice.

Type I.—Ibrāhīm Shāh ..	175·4 grs.
	174·9 grs.
	167·5 grs.
	166 grs.
	148 grs.
Type II.—Ibrāhīm Shāh ..	178·5 grs.
	177·3 grs.
	172 grs.
Maḥmūd Shāh ..	185·2 grs.
	184 grs.
	175·2 grs.
	175 grs.
Ḥusain Shāh ..	184 grs.
	183·5 grs.
	180·3 grs.
	180 grs. (approximate)
	180·7 grs.
	183·4 grs.

Silver.

The silver coins of the Sharqī Kings at present in existence or of which descriptions have been published appear to be limited to two in number, viz.:—

1. A coin of Ibrāhīm Shāh described by Mr. C. J. Rodgers in his article "Coins Supplementary to Mr Thomas' Chronicles of the Pathan Kings of Delhi" No. IV, published at page 183 *et seq* of the Journal of the Asiatic Society of Bengal, Vol LV. Part I, 1886. A woodcut of the coin, which was described as dated A.H. 842. was published with the article No weight was given The coin when described by Rodgers was in the Da Cunha collection; it is mentioned in the printed catalogue of that collection, and apparently later passed into the possession of Dr. White King as it was entered under No. 4366 in the dispersal Sale Catalogue of his collection. I do not know where the coin is now In the latter publication the date is given as A.H. 848. A comparison of the woodcut published by Rodgers with the figure published on Plate VIII of the Sale Catalogue of the White King collection offers conclusive proof that the two illustrations are of one and the same coin; and while chronology would substantiate the reading of the date as A.H 842 rather than A H 848, the actual illustrations appear to suggest the reading "اثنی" instead of ' ثمان " for the unit figure.

The coin was square-shaped with the legends on both faces exactly similar to those on the series described under Gold Type II except that the legend on the obverse is arranged in a square instead of in a circle.

2 A coin of Maḥmūd Shāh in Mr. Nelson Wright's collection The date is not distinct but Mr Nelson Wright thinks the first two figures are 86- The weight is 176 grs. and the coin may possibly have been struck from a gold die of Type II as it is exactly similar in all respects to the coins of that type.

Billon

Ibrāhīm Shāh coined two types in this metal both of which were continued by Maḥmūd, Muḥammad and Ḥusain. Maḥmūd introduced a third type and Ḥusain a fourth.

Type I. The obverse reads:—

"The Khalīf, Commander of the faithful, may his *khilāfat* be perpetuated" followed by the date in figures.

The reverse, in the case of the issue of Ibrāhīm Shah reads:—

"Ibrāhīm Shāh, the Sulṭān, may his kingdom be perpetuated," while the succeeding three kings merely prefixed the words—

"Maḥmūd Shāh son of"
"Muḥammad Shāh son of Maḥmūd Shāh son of"
"Ḥusain Shāh son of Maḥmūd Shāh son of"

to the legend borne on the reverse of the issue of Ibrāhīm Shāh.

Weights.—The coin appears to have been minted by Ibrāhīm, Muḥammad and Ḥusain in one weight only but Maḥmūd would appear to have issued the type in two weights.

Size 1. is the normal size of issue of coins of this type In order to arrive at the average weights of the billon and copper issues of the Sharqī Kings I have weighed the coins in my own collection and have averaged them with the weights of the coins published in the various museum catalogues. The result may be considered as forming a very fair basis for calculating the *average* weights of the coins.[1]

The resultant averages of the coins of this size of the various kings were as follows:—

Ibrāhīm Shāh	..	140·1 grs.
Maḥmūd Shāh	..	145·3 grs.
Muḥammad Shāh	..	150 grs.
Ḥusain Shāh	..	150·7 grs.

The heaviest weight for a coin of Ibrāhīm is reached in a specimen in my own collection which weighs 147 grs. The coin is however corroded. Four specimens of the total number from which the average was struck weigh 145 grs. each.

Maḥmūd issued coins of this size and type weighing as high as 148 grs. of which there are two clean specimens in my collection. A very perfect clean coin in my collection dated [8]36 A.H. weighs however only 129 grs. Ḥusain issued this coinage in as high a weight as 154 grains. I possess two specimens which reach this weight.

Mr. Lane-Poole, at page 89 of his *Catalogue of the Coins of the Muhammadan States of India* in the British Museum considers that the average diameter of this type of coin is ·75 in. and the average thickness ·15 in. I have not had the time to verify these measurements with the larger number of coins now available for comparison, nor do I consider that any useful purpose would result from any such investigation.

Size 2. Mr. C. J. Rodgers catalogued[2] three specimens of a coin which he classed as a separate issue of Maḥmūd Shāh. I have seen the coins and I have been favoured by the Curator of the Lahore Museum with a set of rubbings; I prefer to consider them as intended for coins of this type of half weight. The coins are roughly struck and are crude in the formation of their legends. The three specimens catalogued by Rodgers averaged 78·3 grs. each and ·6 inch in diameter.

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[1] Owing, however, to certain numismatic books not being available to me when concluding this paper I have not been able to employ such a wide range of references in working out the average weights of certain coins. These instances I have denoted with an asterisk.

[2] *Catalogue of the Coins collected by Chas. J. Rodgers and purchased by the Government of the Punjāb. Part II. Miscellaneous Muhammadan Coins*, compiled by Chas. J. Rodgers, Calcutta, 1894.

Type II bears for all four kings the legends already described under Type I, there is however no date on the coin and the obverse legend is somewhat differently arranged.

Average weights	Ibrāhīm	..	55 45	grs.
	Maḥmūd	..	52·5	grs.
	Muḥammad	..	56	grs.*
	Ḥusain	..	57	grs.*

A specimen of the issue of Ibrāhīm weighing as high as 60 grs is in the Indian Museum collection but it is corroded; the next highest weight reached is in a good specimen in my collection which weighs 56 grs. The highest weight for a coin of Maḥmūd Shāh is half a grain higher than the highest of Ibrāhīm Shāh—a specimen in the Indian Museum Collection weighing 56 5 grs.

The only specimen of this issue of Muḥammad in my collection weighs 56 grs.; a specimen in my collection minted by Ḥusain weighs as high as 60 grs.

Type III is confined to a single issue of Maḥmūd Shāh and its circulation may possibly have been limited to the mintages' of one year. The coin was originally figured by Marsden under his No. DCCLV but the margin on his specimen was illegible and he read the date A.H. 844 on the coin wrongly as A.H. 849. It was again figured in the *Catalogue of Coins in the British Museum—Muhammadan States*—(No 295); the margin was again not read and the error of Marsden in reading the date as A.H. 849 was repeated. I suspect that Marsden's coin and the specimen in the British Museum are one and the same coin. The figure in the plate in my own copy of the British Museum Catalogue does not allow of the date being read with any certainty; and in the absence of a better specimen bearing this date I am not prepared to accept the year A.H. 849 as one of the years of issue of this type of the coinage of Maḥmūd Shāh.

The coin was described by Marsden and in the British Museum Catalogue as being of copper and Colonel H. R. Nevill when describing some specimens dated A.H. 844 in the Journal of the Asiatic Society of Bengal, Numismatic Supplement No. XXVI ("A new copper coin of Jaunpūr"), under the impression that it had not previously been published, also described it as of copper. I believe that Colonel Nevill now agrees that the coin is billon.

The obverse legend consists of the king's name in a double circle with a marginal legend "Saifu-d-dunyā wa-d din Abūl-Muz̤affar." The reverse legend reads "Son of Ibrāhīm Shāh the Sulṭān" followed by the date in figures. The weight is 66 grs. and the size 0·6 inch.

Copper.

Type I.—This was the only copper coin struck by Ibrāhīm and the issue was continued by his successors.

The obverse bore the inscription :—

"The K͟halīf, Father of Victory"

followed by the date in figures; the reverse reading :—

"Ibrāhīm Shāh, the Sulṭān."

The succeeding kings retained the same obverse and prefixed their own names to that of Ibrāhīm to form the reverse.

All four kings issued this type of coinage in two sizes. The larger sized coins of Ibrāhīm and Maḥmūd are nowadays much more commonly met with than are those of Muḥammad and Ḥusain, while the lighter weight coin of all four kings is scarce. Although Ibrāhīm and his three successors minted the smaller coin, dated specimens are seldom met with, only one dated specimen (A H. 861) of Muḥammad can be recorded, while of Ḥusain I can record two dates only, viz. A.H. 866 and 867.

Average weights.		*1st Size.*	
Ibrāhīm	..	67·5 grs.	(Highest wt. 70 grs Coll. H. M. W. 6 coins weigh 72 grs each.)
Maḥmūd	..	70 grs.	(Highest wt. 76 grs. I.M.C. The 18 coins catalogued therein average 72 grs.)
Muḥammad	..	69 grs.*	
Ḥusain	..	67·2 grs.*	
		2nd Size.	
Ibrāhīm	..	31·7 grs	(5 coins weigh 33 grs. each.)
Maḥmūd	..	33·7 grs.	(2 coins in Rodgers' Catalogue weigh 37 grs. each one in my Coll. weighs 36 grs.)
Muḥammad	..	Not estimated.	
Ḥusain	..	Not estimated.	

Type II is a small coin issued only by Maḥmūd Shāh and, although Mr. Nelson Wright classes one described by him in the Indian Museum Catalogue as of copper, I am not sure that the issue is not of billon: one in my own collection is of doubtful constitution.

The legends on both faces are similar to those on Type I except that there is no date on the reverse, the figures being replaced by the words "may his *k͟hilāfat* be perpetuated"

The average weight of the coin is 56·8 grs. Two coins, one in the Indian Museum collection (Cat. No. 101) and one entered in the Lahore Museum Catalogue weigh as high as 60 grs. each.

Type III was introduced by Maḥmūd and was continued by his two successors.

The obverse legend consists of the name of the king in a circle with a marginal legend, in the case of Maḥmūd, of—

"Son of Ibrāhīm Shāh the Sulṭān."

The reverse reads:—

"Deputy-Commander of the Faithful"

with the date in figures below.

The coins of both Muḥammad and Ḥusain are exactly similar to the type minted by Maḥmūd except that the two brothers prefixed the name of their father to the genealogical marginal legend.

Average weights—Maḥmūd, 142·9 grs.; one in I.M.C. weighs 150 grs.; several weigh over 145 grs.

Muḥammad, not estimated.

Ḥusain, 145·12 grs.

The following table is perhaps the best means of showing the sequence of "type" of issue of coinage of Ibrāhīm, Maḥmūd, Muḥammad and Ḥusain:—

GOLD.		SILVER.	BILLON.				COPPER.			
TYPE I.	TYPE II.		TYPE I.		TYPE II.	TYPE III.	TYPE I.		TYPE II.	TYP III
			1st size.	2nd size			1st size.	2nd size.		
Ibrāhīm	Ibrāhīm	Ibrāhīm	Ibrāhīm.	Ibrāhīm.			Ibrāhīm	Ibrāhīm		
	Maḥmūd	Maḥmūd (?)	Maḥmūd.		Maḥmūd	Maḥmūd	Maḥmūd	Maḥmūd	Maḥmūd.	Maḥm
			Muḥammad.				Muḥammad.	Muḥammad.		Muḥa mad.
	Ḥusain		Ḥusain				Ḥusain	Ḥusain		Ḥusai

Bahlol Lodī.

Bahlol issued two types of coinage, both of copper, that can with certainty be ascribed to the Jaunpūr mint.

Type I is of approximately 70 grs. weight and bears on the obverse the inscription "Bahlol Shāh Sulṭān," the reverse reading "The city of Jaunpūr" with the date in figures below.

Type II is represented by a single coin in the collection of Mr. Burn and I do not know its weight. It is similar to Type I except that the title "Sulṭān" is omitted on the obverse.

Bārbak Shāh.

As Sulṭān, Bārbak issued at least three types of coinage, all in billon.

Type I consists of the issue of coinage in the remarkable weight of 120 grs.

The obverse bears a central inscription "Bārbak Shāh Sulṭān" with a marginal legend, the purport of which is doubtful. In the catalogue of coins which follows I have retained the hitherto accepted reading of the reverse of this type of issue, viz. "Deputy-Commander of the Faithful at the city of Jaunpūr" followed by the date in figures. I am however by no means satisfied that this is the correct rendering of the inscription.

Type II appears to be similar to Type I except that there is no trace of a marginal inscription on the obverse. It is limited to a single specimen in Mr Burn's collection.

Type III which is again represented by a single coin in Mr. Burn's collection consists of the inscription "Bārbak Shāh, the Sulṭān" on the obverse, with "The city of Jaunpūr" on the reverse, followed by the date in figures.

I am unable to state the weights of the coins described above under Types II and III.

3. *Catalogue of Coins.*

Ibrāhīm Shāh.

Gold.

Type I.	*Obv.*	*Rev.*
	In Circle. فے زمن الامام امبر المومنين ابو الفتح خلدت خلافته	السلطان الاعظم الد نيا شمس والدبن ابو المظفر ابراهيم شاه السلطانى خلدت مملكة

Margin :—

ضربت هذا الدينار في سنة ....

Dates :—830 A.H. (wt. 175·4 grs.), Coll. Brit. Mus.
831 A.H. (wt. 166 grs.), B.M.C. No. 223.
836 A.H., White King Sale Cat No. 4363.

Type II. In Circle.	In Tughra.
في زمن الامام	الواثق بتائيد الرحمن
نائب امير المومنين	ابو المظفر ابراهيم شاه
ابو الفتح خلد	السلطان
خلافته	

Margin :—

ضربت هذا الدينار في سنة ....

Dates :—840 A H. (wt. 177·3 grs.). Thomas No. 1 (*a*).
841 A H. (wt. 172 grs.), I.M.C. No. 1.
842 A.H (wt. 178 5 grs.), Coll. Brit. Mus.
843 A.H , Coll. R. Burn.

Silver.

Obverse and reverse exactly as above, but of square shape and legend on obverse enclosed in square.

Date :—842 A.H., Rodgers, J.A.S.B., 1886, p. 187. No. 8 (cf. also White King Sale Cat. No. 4366).

Billon.

Type I الخليفه امير	شاه
المومنين خلدت	ابراهيم
[date] خلافته	سلطاني خلدت
	مملكة

Av. wt. 140·1 grs.
For dates see table which follows.

Type II. الخليفة	
المومنين	
امـــــير	As above.
خلد خلافته	

Av. wt. 55·45 grs.

Copper.

Type I. خليفه	شاه
ابو الفتح	ابراهيم
[date]	سلطاني

Size 1. Av. wt. 67·5 grs.
Size 2. Av. wt. 31·7 grs.
For dates see table which follows.

Mahmūd Shāh.

Gold.

Type II.	As on type.	In Tughra.[1] سيف الدنيا والدين ابو المجاهد محمود شاه ابراهيم شاه السلطان

Dates :—846 A.H. (wt. 175 grs.), B.M.C. No 263.
847 A.H. (wt. 185·2 grs.), Ellis Sale Cat. No. 491.
855 A.H. (wt. 175·2 grs.), Thomas No. 5(*b*) (but see p. 18*n*).
856 A H. (wt. 184 grs.), Coll. H. R. Nevill.

Silver.

As above.	As above.

Date :—86 × A.H. (wt. 176 grs.), Coll. H. Nelson Wright.

Billon.

Type 1.	As on type.	محمود شا بن ابراهيم شاه سلطانے خلدت مملكة

Size 1. Av. wt. 145·3 grs.
Size 2. Av. wt. 78·3 grs.[2]
For dates see table which follows.

Type II.	As on type	As above.

Av. wt. 52·5 grs.

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[1] The British Museum Catalogue gives an inscription identical with the one given above (for which I have to thank Colonel Nevill) except that "ضرب السلطان" is entered at the beginning. This is not on Colonel Nevill's coin.

[2] The Catalogue of the coins collected by Rodgers and purchased by the Panjāb Government contains an entry of a coin of 33 grs. wt. and ·55 in diameter, of which Rodgers read the inscription as in this type. Rodgers added a note to the effect that the coin had not been edited by Thomas and was not in the British Museum. This type may therefore have been issued in three different weights.

Type III. In a double circle

شاہ محمود	شاہ بن ابراهیم سلطانی ۸۴۴

Margin :—

سیف الدنیا والدین ابو المظفر

Date:—844 A H. (wt. 66 grs.), Nevill, J.A.S.B., N.S. XXVI.

Copper.

Type I.	As on type.	شاہ محمود بن ابراهیم شاہ سلطانے

Size 1. Av. wt. 70 grs.
Size 2. Av. wt. 33·7 grs.
For dates see table which follows.

Type II.	الخلیفة ابو الفتح خلد خلافته	As above.

Av. wt. 60 grs.

Type III.	In a circle شاہ محمود	المومنین نائیب امیر [date]

Margin :—

بن ابراهیم شاہ سلطان

Av. wt. 142·9 grs.
For dates see table which follows.

Muhammad Shāh.

Billon.

Type I	As on type	محمد شاہ بن محمود شاہ بن ابراهیم شاہ سلطانے خلدت مملکة

Av. wt. 150 grs.
Dates :—861 A.H., Coll. H.R. Nevill.
862 A.H., B.M.C. No. 296.
863 A.H., Bodleian Cat. 619(*k*).

Type II.	As on type.	As above.

Wt. 56 grs.
Coll. H. M. Whittell, apparently not previously edited.

Copper.

Type I.	As on type.	محمد شاه بن محمود شاه بن ابراهیم شاه سلطانی

Size 1. Av. wt. 69 grs
Dates :—861 A.H., B.M.C. No. 300
862 A.H., B.M.C. No. 301.
863 A H., Coll. H. R. Nevill

Size 2. Av. wt. not estimated.
Date. 861 A.H.

Type III.	In a circle شاه محمد	As on type.

Margin :—
بن محمود شاه بن ابراهیم شاه سلطانی

Av. wt. not estimated.
Dates :—861 A.H., B.M.C. No. 297.
862 A.H., B.M.C. No. 298.
863 A.H., B.M.C. No. 299.

Husain Shāh.

Gold.

Type II.	As on type.	In Tughra.[1] المؤيد بتائيد الرحمن حسين شاه محمود شاه براهيم شاه السلطان خلد الله مملكة

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[1] The Indian Museum Catalogue gives the inscription as "المؤيد بتائيد الله ابو المظفر حسين &c.," Colonel Nevill has supplied the reading which I give above.

Dates :—865 A.H. (wt. 180 grs.), Coll. H. R Nevill.
87 × A.H. (wt. 183·4 grs.), Coll. Brit. Mus.
× × 2 A.H. (wt. 180·7 grs.), Coll. Brit. Mus

Billon.

Type I. As on type.

حسین شاه
ـن محمود شاه
بن ابراهیم شاه
سلطانی خلدت
مملكة

Size 1. Av. wt. 150·7 grs.
Size 2. Av. wt. 78·3 grs.
For dates see table which follows.

Type II. As on type. — As above.

Av. wt. 57 grs

Type III.

الخلیفه
امیرالمو
منین ۹۰۱
خلد خلافته

As above.

Date :—901 A.H. (wt. 70 grs.), Coll. H R. Nevill.

Copper.

Type I. *Obv.* As on type

Rev.
حسبن شاه
بن محمود شاه
بن ابراهیم شاه
سلطانی

Size 1.
Average wt. 67·2 grs.
Size 2.
Average wt. not estimated.
For dates see table which follows.

Type III. *Obv.* In a circle.

شاه
حسین

Margin :—
بن محمود شاه بن ابراهیم شاه
سلطانی

Rev. As on type.

Average wt. 145·12 grs.
For dates see table which follows.

Bahlol Lodī.

Copper.

Obv.	*Rev.*
بهلول شاه	شهر
سلطان	جونپور
	٨٨٨

Average wt. 70 grs.
Dates :—888 A.H., I.M.C. No. 579.
889 A.H., I.M.C. No. 580.
890 A.H., Rodgers Cat. p. 112, No. 3.
891 A.H., Coll. H. R. Nevill.
892 A.H., Coll. H. R. Nevill.
893 A.H., I.M.C. No. 581 (fig.)

N.B.—Rodgers in his Catalogue (p. 112, No. 3) mentions a coin of this type dated 878 A.H. This must have been wrongly read.

Obv.	*Rev.*
بهلول	As above.
شاه	

Date :—889 A.H. (or 891 A.H.) Coll. R. Burn.

Bārbak Shāh.

Billon.

Obv.	*Rev.*[1]
In a circle	
	المومنين
بار بكشاه	اميــــر
سلطان	نائــــب
	بشهر جونپور
	٨٩٢

Margin :—Not yet determined.
Average wt. 120 grs.
Date :—892 A.H., Thos. No. 322.
894 A.H., Thos. No. 322.
895 A.H., Coll. H.R. Nevill.
898 A.H., B.M.C. No. 342.

[1] See remarks on p. 25 *ante.*

Table of Dates.

DATE.	BILLON TYPE I.				COPPER		
					Size 1.		
A H.	Ibrāhīm.	Mahmūd.	Muḥammad.	Ḥusain.	Ibrāhīm.	Maḥmūd.	Muḥammad.
813	Thos. 3	....	....	....	Nevill	....	....
814	....	....	....	....	,,	....	....
815	....	....	....	....	....	....	....
816	....	....	....	....	Burn	....	....
817	....	....	....	....	....	....	....
818	Whittell	....	....	....	I.M.C. 8	....	....
819	....	....	....	....	B.M.C. 237	....	....
820	B M.C. 224	....	....	....	,, 238	....	....
821	,, 225	....	....	....	,, 239	....	....
822	Nevill	....	....	....	,, 240	....	....
823	....	....	....	....	,, 241	....	....
824	Nevill	....	....	....	,, 242	....	....
825	B.M.C. 226	....	....	....	,, 243	....	....
826	,, 227	....	....	....	,, 244	....	....
827	,, 228	....	....	....	,, 245	....	....
828	,, 229	....	..	....	,, 246	....	....
829	I.M.C. 3	....	....	....	,, 247	. ..	....
830	B.M.C. 230	....	....	....	,, 248	....	....
831	Whittell	...	....	....	,, 249	....	....
832	I.M C. 4	.. .	....	....	,, 250	....	....
833	B M.C. 231	....	.. .	....	,, 251	....	....
834	,, 232	....	....	....	,, 252	....	....
835	Whittell	....	....	....	,, 253	....	....
836	B.M.C. 233	Whittell	....	....	,, 254	....	....
837	,, 234	Nevill	....	....	,, 255	B.M.C 285 ?	....
838	I.M.C. 6	....	....	....	,, 256	....	....
839	,, 7	....	....	....	,, 257	....	....
840	B.M C. 235	....	....	. ..	,, 258	....	....
841	L.M.C. p. 104	...	....	....	,, 259	....	....
842	Whittell	....	....	. ..	,, 260	....	....
843	B.M.C 236	....	....	....	,, 261	....	....
844	....	B.M.C 265	....	....	I.M C. 53	B.M.C. 273	....
845	....	,, 266	..	....	..	,, 274	....
846	Whittell	I.M C. 62	....	....	Horwood	,, 275	....
847	Nevill	,, 63	....	....	....	,, 276	....
848	....	B.M.C. 267	....	....	....	,, 277	....
849	....	Thos. No. 4 p. 322.	....	....	....	I.M.C. 82	....
850	....	I.M.C. 65	....	....	....	B.M.C. 278	....
851	....	B.M.C. 268	. ..	....	....	,, 279	....
852	....	,, 269	....	....	....	,, 280	....
853	....	,, 270	....	....	....	,, 281	....
854	....	I.M.C. 66	....	....	....	,, 282	....
855	....	Whittell	....	....	....	I.M.C. 92	....
856	....	B.M.C. 272	....	....	....	,, 93	....
857	....	Whittell	....	....	....	Nevill	....
858	....	,,	....	....	....	I.M.C. 94	....
859	....	,,	....	....	....	B.M.C. 283	....
860	....	Nevill	....	....	....	I.M.C. 97	....
861	....	Rodgers Cat. p. 126.	Nevill	Nevill	....	B.M.C. 284	B.M.C. 300
862	....	Nevill	B.M C. 296	I.M.C. 111	....	Bod. Cat. 617	,, 301
863	....	....	Thos. No. 5 (d) p. 322.	Nevill	....	....	Nevill
864	....	....	....	,,	....	..	....
865	....	....	....	B.M.C. 303	. ..	I.M.C. 100	....

TYPE I.					COPPER TYPE III.			
	SIZE 2.							
Ḥusain.	Ibrāhīm.	Maḥmūd.	Muḥd.	Ḥusain.	Ibrā-him.	Maḥmūd.	Muḥammad	Ḥusain.
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	Nevill	....	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	Nevill	.. .	..	....	..	....	...	....
....	I.M.C 55	....	..	....	..	....	....	....
....	,, 56	....	..	....	..	....	....	....
..	....	.. .	..	....	..	....	....	....
....	Nevill	....	..	....	..	....	....	....
....	....	....	..	....	..	..	....	....
....	Nevill	....	..	....	..	....	....	...
....	B.M.	....	..	....	.	....	....	....
..	Nevill	..	..	....	..	...	....	....
....	Bod. Cat 605	. .	..	....		. ..	. ..	....
....	Nevill	..	..	....	..	. ..	....	.. .
....	....	..		...	..	....	....	....
....	Bod. Cat. 606	....	..	....	..	....	. ..	....
....	....	...	..	....	..	..	...	....
....	Burn	..	.	....	..	....	...	.
.. .	I.M.C. 57	....	..	....	..	....	....	....
....	Bod. Cat. 607	..	..	....	.	....	....	....
...	I.M.C. 59	....	..	....	..	....	....	....
. .	....	Nevill	..	.. .	..	B.M.C. 288	....	....
.. .	....	,,	..	....	..	,, 289	....	....
....	....	Rodgers Cat. p. 126.	..	....	..	..	....	....
....	....	....	..	....	..	Nevill	....	....
....	....	I.M.C. 103	..	....	..	....	....	....
....	....	....	..	....	..	....	....	....
....	....	Rodgers Cat p. 126.	..	....	..	B.M.C. 290	....	....
....	.. .	....	.	....	..	,, 291	....	....
....	....	I.M.C. 104	..	....	..	,, 292	....	....
....	....	B.M.C. 286	..	....	..	I.M.C. 69	....	....
....	....	Whittell	..	....	..	,, 70	....	....
....	....	....	..	....	..	Rodgers Cat. p. 127.	....	....
....	....	....	..	....	..	I.M.C. 71	....	....
...	....	....	..	....	..	....	....	....
....	....	B.M.C. 287	..	....	..	B.M.C. 293	....	....
....	....	....	..	....	..	....	....	....
....	....	....	..	....	..	B.M.C. 294	....	....
....	....	....	B.M.	....	..	....	B.M.C. 297	....
Rodgers p. 128	....	....	..	....	..	Bod. Cat. 618	,, 298	....
B.M.C. 326	....	....	..	....	..	....	,, 299	....
,, 327	....	....	..	....	..	....	....	B.M.C. 336
,, 328	....	....	..	....	..	....	....	Whittell

Table of Dates.

DATE.	BILLON TYPE I.	COPPER TYPE I.		COPPER TYPE III
		SIZE 1.	SIZE 2.	
A.H.	Ḥusain.	Ḥusain.	Ḥusain.	Ḥusain.
866	I.M.C. 113	B.M.C. 329	Nevill	I.M.C. 161
867	Whittell	,, 330	Bod. Cat. 626 (t).	,, 163
868	B.M.C. 304	,, 331	....	,, 164
869	,, 305	....	....	B.M.C. 337
870	,, 306	....	. ..	....
871	I.M.C. 116	....	....	....
872	B.M.C. 307	....	....	Ellis Sale Cat.
873	Whittell	Nevill	....	....
874	B.M.C. 308	....	....	....
875	I.M.C. 120	....	....	Rodgers p. 128.
876	,, 122	....	....	....
877	B.M.C. 309	W.K.	....	....
878	I.M.C. 125	L.M.C. p. 105	....	Nevill
879	B.M.C. 310	....	....	Ellis Sale Cat.
880	I.M.C. 128	Nevill	....	....
881	B.M.C. 311	W.K.	....	....
882	I.M.C. 132	....	....	....
883	B.M.C. 312	Whittell	....	....
884	I.M.C. 135	B.M.C. 332	....	Rodgers p. 128.
885	,, 136	,, 333	....	B.M C. 339
886	B.M.C. 313	W.K.	....	....
887	,, 314	B.M.C. 334	....	I.M.C. 166
888	Whittell	....	....	....
889	B.M.C. 315	.. .	...	
890	Nevill	....	..	..
891	Whittell	. .	....	....
892	I.M C. 139	. ..	....	....
893	Nevill	....	....	....
894	Whittell	....	....	....
895	,,	Nevill	....	....
896	B M.C. 316	W.K.	....	....
897	,, 317	,,	....	....
898	I M.C. 143	....	....	....
899	B.M.C. 318	W.K.	....	....
900	,, 319	....	....	....
901	,, 320	Nevill*	....	....
902	I.M.C. 149	....	....	....
903	B.M.C. 321	....	....	....
904	,, 322	....	....	....
905	,, 323	W.K.	....	....
906	,, 324	....	....	....
907	I.M.C. 154	W.K.	....	....
908	Whittell	....	....	....
909	B.M.C. 325	....	....	....
910	I.M.C. 155	W.K.	....	....
911	L.M.C. p. 105	....	....	....
912	,,	....	....	....
913	,,	....	....	....
914	,,	....	....	....
915	,,	....	....	....
916	,,	....	....	....
917	....	....	....	....
918	....	....	....	....
919	Whittell	....	....	....
920	....	....	....	....

* Billon Type III.

	Obv.	*Rev.*
(*Sic*)	با بکشاه سلطان	As above.

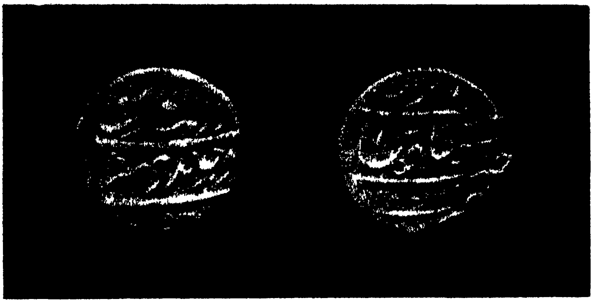
Date :—895 A.H., Coll. R. Burn.

Obv.	*Rev.*
بار بکشاه سلطانی	شهر جونپور ۸۹۵

Date :—895 A.H., Coll. R. Burn.

H. M. WHITTELL.

229. A NUṢRATĀBĀD RUPEE OF AURANGZEB.



Mint—Nuṣratābād.
Metal—Æ.
Size—·9.
Weight—177 grs.
Date—32 R.Y.

Obv.	*Rev.*
اورنگ زیب عالمگیر	مانوس
زد چو بدر منیر	میمنت
سـکـه	سنه ۳۲ جلوس آباد
در جهان	ضرب
	نصـرت.

In the course of classifying certain coins in the Provincial Museum, Lucknow, I discovered the above rupee of Aurangzeb, Nuṣratābād mint, which I presume is the earliest struck there by Aurangzeb. From an extract reproduced in the Numismatic Supplement No. XII, Art. 73, we find that on the 2nd Ṣafar, 1099 A.H. (Dec. 7, 1687), this place viz. Sakkhar or Ṣagar

(Nuṣratābād) was taken by the Mughals from Peḍā Naik, caste Ḍheḍh, who was introduced at court on the 2nd Rab'ī II (February 5, 1688).

This coin is dated in the 32nd regnal year (or A.H. 1099–1100) corresponding to A.D. 1688–89 which is the first year in which the town came under the complete sway of the Mughal Imperial Government.

PRAYAG DAYAL.

230. NOTE ON A SILVER COIN OF QUṬBU-D-DĪN MUBĀRAK I.

Mint—Dāru-l-Islām.
Date—717 A.H.
Metal—Æ.
Weight—168·5.
Size—1·2.

Obv.

الامام الا عظم
خليفة ربّ العالمين
قطب الدنيا والدين
ابو المظفر

Rev. In circle

مبارک شاه السلطان
ابن السلطان الواثق
بالله امير المومنين

Margin. ضربت هذه الفضه بدار الاسلام في سنة سبع عشر و سبعمائة

But for the king's name which appears on the reverse, the obverse legend corresponds with the square piece noticed under I.M.C. 248.

The legend inside the circle is the same as that on I.M.C. 245, but مبارکشاه is written as مبارک شاه. The marginal legend is complete and the coin is in a perfect state.

It was found in Kaurala, Pargana Hassanpur, district Moradabad, in 1905, and is now in the Provincial Museum, Lucknow.

PRAYAG DAYAL.

231. THE EPITHET USED ON COPPER COINS BY IBRĀHĪM ‘ĀDIL SHĀH II OF BĪJĀPŪR.

On page 683 of Vol. VI (1910) of the J.A.S.B., Numismatic Supplement No. XV, Dr. Taylor reads the legend on the copper coins of Ibrāhīm II of the ‘Ādil Shāhī Dynasty of Bījāpūr as—

Obv. ابراهيم بلا ابلى
Rev. غلام على مرتضى

With regard to the epithet used after Ibrāhīm, he says: "After many attempts to decipher them, the last two words on the obverse of Types III, IV, and V (all having the same legend as noted here) still remain doubtful. They may possibly read بلا اثنی bila athni. 'without a second,' 'the unique,' but certainly the penultimate letter seems on every specimen to be not *nūn*, but *lām*." Now if we turn to Plate XXXIX of the same number, we find Nos. 2, 3 and 4 of the plate[1] corresponding to Types III IV and V in the above note. Since handling the coins of Ibrāhīm 'Ādil Shāh II and carefully looking at these figures, I have come to the conclusion that the word is not بلا اثلی but is most probably ابلا بلی which means the "Friend of the Weak." In Muhammadan numismatics and epigraphy, especially where artistic arrangement is to be observed, clerical accuracy is often sacrificed for the sake of symmetry and ornamentation, e.g. sometimes a letter is altogether omitted, one serving for the two, or is placed at a distance from its proper position. This is what has happened here. In fig. 2 of the plate, obverse side, there are three isolated *alifs*. Now two out of these are so placed that one is on the right and one is on the left of the central *alif* which is so lengthened that it exactly bisects not only the surface of the coin but also the lettering on it. Reading from the bottom, as the coin is to be read, we find ا (alif), (ب) (be), ه (he) ب (be) and ل (lām) on the right of the central *alif*, and ا (alif), م (mīm), ب (be) ل (lām), and ی (ye) on the left; while ر (re), ی (ye) and ا (alif) are divided into two parts. This big *alif* also shows that it is the first letter of the second half of the legend on the obverse. there being seven letters of *Ibrāhīm* (ابراهیم) and seven of *abalā balī* (ابلا بلی). The same remarks apply to fig. 3 of the plate and this type we find exhibits more artistic taste than that displayed in figure 2. Here not only the letters and the scalloped border are divided into two halves by the *alif* of ابلا بلی (which is not so prominent as in fig. 2), but the outer circle of dots is also divided into two parts so that there are twenty dots on the right and twenty on the left of the *alif*. Figure 4 also has the *alif* between بلا (balā) and بلی (balī).

What I have said above, seemed at first to me a mere conjecture; but while perusing a MS. of the *Kitāb i Nauras*,[2]

---

[1] It should be noted that the coins illustrated in the plate are reconstructions. *Ed.*

[2] The "Kitāb-i-nauras" was written by Ibrāhīm 'Ādil Shāh II of Bījāpūr. The MS. was bought in June 1921, for the Prince of Wales Museum.

I came upon the following verse on page 21, which confirms my reading :—

انترا

تِرْ لُوكْ جَپَتْ تُوَ نَانْوْ پَاوِنْ پَرَانْ كِيْ پُرَانْ

اَچْرجُ مَہَا بِیرْ اَبَلَا بَلِیْ تُو نِہِیْں سَانچُو اَوْتَارْ

Transliteration : Tirlok japat tuwa nāṇw pāwīṇ parān kī purān

Acharju mahābīr *abalā balī* tūṇhiṇ sāṅchu autār.

Translation : "Three worlds repeat thy name (at thy feet, oh breath of old !).

O Wonder! O Great Hero, *friend of the weak*, thou alone art the true incarnation."[1]

I leave comment on the true significance of certain words in the above *antra* to a later paper on this MS., but there can be no other meaning of the word *abalā balī*, which is the real point of this discussion. At the risk of rendering this note rather lengthy, I may be permitted to quote the following lines from Basātīnu-s-Salāṭīn, the standard history of the 'Ādil Shāhīs of Bījāpūr. The author while discussing the word نورس *Nauras*, which was much favoured by Ibrāhīm II says on pp. 249–250 (Hyderabad Edition): —

و کتابی که بزبان دهرپت درفن موسیقی تالیف یافته و آنرا به بادشاه مخصوص میکند بنورس مشهور است و فلوس که ازان عهد تا زمان حال مشهور و مروّج است هم بفلس نورس معروف است *

"And a book, written in the language of Dharpat on the art of music, is assigned to the King and is known as *nauras*. And *fulūs* (pice) which are current from that date up to this time, are also known by the (name) of *fals-i-nauras* (the nauras pice)." Now we find the *fals i-nauras* (these very coins) have a legend on them which is, or the like of which, is given in the *Kitāb-i-nauras*, the title of the book quoted above, and both these belong to the same period if not the same year

Thus the epithet used on the copper coins of Ibrāhīm II is *abalā balī* [ابلا بلي] which means the "Friend of the weak."

MUHD. ISMAIL.

9th March, 1922.

---

[1] Professor N. B. Divatia of Elphinstone College, Bombay and Mr. G. V. Acharya of the Prince of Wales Museum, helped me to translate the above couplet, save the words provisionally translated in brackets, which are doubtful. These may be cleared up by an expert in Hindi.

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* Page-numbering mistakenly the same as for No. 8; namely, 93–128.

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* *See* Vol. II, No. 3.

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